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Matter in Motion:
The Problem of Activity in Seventeenth-
Century English Matter theory

by

John Christopher Henry, B.A., Cert. Ed., M. Phil.

A thesis offered for the degree of Ph.D. in the
History of Science, at the Faculty of Arts, The
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ABSTRACT

This thesis considers some of the ways in which leading seventeenth-century English mechanical philosophers tried to account for the various motions of matter which played such a fundamental role in their philosophies. It argues that the Cartesian mechanical philosophy, in which matter is considered to be completely passive and inert and the amount of motion in the universe is constant (being merely transmitted and transferred by impacts), gained no fully committed adherents in England. Only Thomas Hobbes tried to develop a similarly 'strict' mechanical system based on a concept of passive matter and his system completely failed to win support. All the other major thinkers examined in this study either show a marked tendency towards a belief in a concept of active matter or include in their systems some kind of physical principle capable of activating matter.

After the Introduction, in which the scope of the enquiry is delineated, Chapter 1 argues that the mechanical philosophers attempt to explain everything in terms of 'matter in motion' presented them with the metaphysical problems of defining matter and accounting for its motions. Subsequent chapters show the ways in which Hobbes, Sir Kenelm Digby, Walter Charleton, Henry More, Robert Boyle, Robert Hooke, Sir William Petty and Isaac Newton tried

to account for the motions and other activities of matter. In the Conclusion it is reasserted that the concept of passive inert matter was never a major feature of seventeenth-century mechanical philosophy.

This thesis also addresses itself to recent historiographical trends about the extra-scientific origins of the Scientific Revolution in seventeenth-century England. In particular it considers the attempts by recent commentators to show that a dichotomy between 'strict' mechanists who believed in passive matter and those who believed in active matter was merely a reflection of widely differing religious-political views: Anglican-conservative on the one hand and Sectarian-radical on the other. It is argued that these historiographical positions are inadequate because they are based on false assumptions about the nature of seventeenth-century matter theory.

Parts of Chapter 1, Section 3 of this thesis have previously appeared in my article: 'Thomas Harriot and atomism: a reappraisal', History of Science, 20, (1982), 267-96. Sections 1, 2 3 and 5 of Chapter 3 have appeared in a slightly amended form in 'Atomism and eschatology: Catholicism and Natural philosophy in the Interregnum', British Journal for the History of Science, (1982), 211-39. No part of this thesis has been previously submitted for any other degree or qualification. It is entirely my own work.

John Henry

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John Henry

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here of the seventeenth-century sources into which I have delved can hardly convey the intellectual pleasure they gave me. Furthermore this thesis would have been impossible without the help of other scholars whose labours helped me to make my own contribution. Thanks to them I recognised the truth of Robert Hooke's words: 'the more you are informed, the more able you are to inquire for and seek after what is considerable to be farther known concerning that Subject' (Posthumous works, 1705, p. 186).

INTRODUCTION

The mechanical philosophy of nature sought to explain all physical phenomena (and many mental phenomena) solely by matter in motion. All change in the natural world was to be conceived as the result of the rearrangement in space of material bodies of different sizes and shapes. This rearrangement of bodies was caused by their various motions and interactions as they came into contact with one another, uniting to form new bodies or rebounding to cause further interactions and further changes. In the strictest version of the mechanical philosophy, exemplified by Descartes' Principia philosophiae (1644) and Hobbes' De corpore (1655), matter was regarded as completely inert and passive and the motions of the system all derived from an initial thrust, provided by God at the Creation and subsequently distributed and transferred in accordance with the so-called 'laws of motion'.¹ It is universally acknowledged that this strict form of mechanical philosophy is a seventeenth-century phenomenon; it originated in the works of Galileo, Beeckman, Mersenne, Descartes and Hobbes in the early years of the century. But by 1701 John Keill, a leading natural philosopher, felt able to say that 'in most of the writings of the Philosophers, there is scarce anything mechanical to be found'.² Historians usually attribute this fundamental change in

the character of natural philosophy to the influence of Isaac Newton. It is he who brought back into natural philosophy 'active principles', actions-at-a-distance, and other 'occult qualities' which the mechanical philosophy had sought to exclude, or so it is alleged.³

It is the object of this thesis to show that in English natural philosophy, at least, active principles were never really dispensed with, even before Newton. I hope to be able to demonstrate that the leading mechanical philosophers in England all felt the need at some stage in their speculations for an active principle, other than God, continuously operating in the Universe. It was this active principle, whatever it might be, which provided and accounted for the various motions of matter which the mechanical philosophy required. The evidence which could be marshalled in support of this thesis is surprisingly vast and I have had to limit my coverage in a number of ways.

Most obviously, I have concentrated on a small number of the leading mechanical philosophers of the time. I could have extended my argument enormously by considering a number of lesser thinkers. However, by concentrating on the major thinkers I believe I have provided the strongest case. If I had chosen to devote most of my attention to minor characters my

efforts would have been open to the charge that they did not represent the thought of the most influential seventeenth-century natural philosophers.⁴ Similarly, I have tended to concentrate on the published works of the philosophers I have dealt with in order to avoid suspicions that I have to seek my evidence in rejected parts of a philosopher's output.

I have also tried, as much as possible, to gather my evidence from treatments of general principles. That is to say, I have tried to concentrate on those aspects of my author's works where some form of active principle is introduced as an indispensable metaphysical principle. Here again, I believe I can provide the strongest case. It would certainly have proved easier to show the use of active principles in seventeenth-century chemical and medical theories which were also offered by the majority of my chosen representatives. Admittedly my decision to exclude chemical and medical notions is somewhat arbitrary and artificial but these facets of the mechanical philosophy have been covered to a large extent in Robert Frank's recent study of Harvey and the Oxford physiologists. Frank's investigation culminates with the work of John Mayow (1641-1679), and what Frank refers to as his 'general physiology of active particles'.⁵ It should be recognised, however, that even Frank's study fails to provide a complete coverage of the role of active principles in seventeenth-century iatromechanism. Consider, for example,

the work of Francis Glisson (1597-1677) whose Treatise on the energetic nature of substance (1672) provides unequivocal support for my contention that general systems of natural philosophy in early modern England often relied upon unexplained inherent activity in nature.⁶ Similarly, Sir Kenelm Digby's ideas were clearly influenced by alchemical and medical traditions and Walter Charleton was essentially a medical theorist whose approach was influenced as much by the vitalistic William Harvey (1578-1657) as the mechanistic Pierre Gassendi (1592-1655).⁷

In confining myself to considerations of activity in nature as a metaphysical principle I have also avoided a re-examination of the more technical developments in seventeenth-century dynamics which led to the modern concept of force in the work of Newton and Leibniz. This aspect of the story has been admirably covered in Richard S. Westfall's Force in Newton's physics and Alan Gabbey's 'Force and inertia in seventeenth-century dynamics'.⁸ I hope that my thesis may be regarded as complementary to those works; certainly it should be supplemented by them. Westfall and Gabbey are both dealing with the development of the concept of force as a functional ingredient in the science of dynamics. 'Force' in this sense is essentially a mathematical

concept which can be expressed in terms of the mass and speed of a particular body, and was often regarded merely as 'quantity of motion'.⁹ What I am concerned with, however, is the way in which seventeenth-century writers tried to explain the cause of such motion.

Leibniz made this distinction clear:

... although all particular phenomena of nature can be explained mathematically or mechanically by those who understand them, it becomes more and more apparent that the general principles of corporeal nature and of mechanics themselves are nevertheless metaphysical rather than geometrical and pertain to certain forms or indivisible natures as the causes of what appears rather than to the corporeal or extended mass.¹⁰

I have needed no further encouragement to focus my attention on the metaphysical rather than the geometrical aspects of these developments.

Finally, it must be said that I have restricted myself to the immediate relevance of the concept of active principles to developments in natural philosophy. Underlying all the ideas I deal with, however, are changing ideas on the nature of causality which belong to a much wider philosophical context. The notion of cause and effect in the strict version of the mechanical philosophy seems, superficially, to be perfectly simple: one body affects another by contact action, imparting motion by impact. As the mechanical philosophy in England began to recognise more openly the need for active powers to explain physical phenomena, a new concept of

causation had to be introduced. The culmination of this aspect of the intellectual revolution in England can be seen in the causal scepticism of David Hume (1711-1776). Hume's contention, that observations of repeated impacts tell us nothing about how one moving object causes another object to move, derived from the work of earlier natural philosophers which seemed to indicate the obscurity of our notions of causality. This is an extremely important facet of seventeenth-century thought which is only touched upon briefly in this thesis. However, a number of recent articles should be considered as essential supplements to my treatment. Keith Hutchison's article on 'Occult qualities in the Scientific Revolution' concentrates on natural philosophy, while R. M. Mattern has shown how contemporary natural philosophy influenced Locke's and Hume's ideas on the nature of causation.¹¹

The beginnings of this reassessment of the nature of causality are perhaps to be found in the reactions of Henry More to the theories of Descartes. According to More, Descartes' laws of motion can only make sense if interpreted vitalistically:

he is fabricating some kind of life in that when two bodies meet he is able to accomodate their motions so that each of them, notified by the other, the one about acceleration of its motion, the other about retardation of its motion, finally agrees on the same course of motion. And it is the same thing for the other laws of transport. For Descartes himself scarcely dares to assert that the motion in one body passes into the other ...¹²

More's follower, Joseph Glanvill, took a similar view of causality and he, in turn, as R. H. Popkin has shown, influenced Hume's view of causality.¹³ Similar ideas on the inadequacy of strictly mechanical notions of causality may even be found in the philosophy of Thomas Hobbes; so S.I. Benn seems to suggest in his study of 'Hobbes on power'.¹⁴

Evidence and arguments like these tend to support my own belief that the Cartesian concept of passive and inert matter which historians all too often regard as an essential feature of the mechanical philosophy was never really accepted in England. On the contrary, English thinkers seem to have agreed implicitly with Leibniz in rejecting the concept of passive and inert matter as an ontological impossibility.¹⁵

A synoptic treatment of all these facets of seventeenth-century thought would undoubtedly enrich our understanding of the beginnings of modern science and philosophy. My own contribution in this thesis is far less ambitious in its scope. I have simply tried to show some of the ways in which the leading English mechanical philosophers relied upon some form of self-active principle, usually a self-active material principle. This task is particularly urgent at this time because the misconception that the mechanical philosophy relies upon a concept of

completely passive matter is being used to argue for a number of historiographical positions which are rapidly becoming part of a new orthodoxy. These flourishing historiographical approaches seek to link the mechanical philosophy to contemporary socio-political developments in what seems to me to be a quite unacceptable way. And that is why my thesis also considers the validity of these 'ideological reconstructions' of modern science; and if my own conclusions on this are far from incontrovertible, I hope they will at least serve to show the inadequacy of the opposing case.

CHAPTER 1

MECHANISMS OF MATTER:

'ATOMS AND THE VOID' vs. 'MATTER IN MOTION'

The mechanical philosophy can be epitomised as the endeavour to account for all physical phenomena in terms of the arrangement and rearrangement in space of the material constituents of bodies. The texture, consistency, colour and other attributes of body are all said to derive from the disposition or motions of the matter which makes up that body. Accordingly, physical change is regarded as nothing more than the redistribution of matter in space: either on a large scale in the case of local motion, or on an invisibly small scale in the case of changes in state or consistency. This being so, the historian may well expect the seventeenth-century proponents of the mechanical philosophy to wholeheartedly embrace the newly revived matter theory of ancient atomism.¹

However, in her pioneering study of 'The establishment of the mechanical philosophy', Marie Boas Hall has argued that the matter theory underlying the mechanical philosophy was not merely a further development in the revival of the ancient atomistic matter theory of Democritus or Epicurus.² In subsequent essays she has reiterated this point, claiming that the matter theory underlying the mechanical philosophy was at the

same time non-Aristotelian and non-atomic. She has even gone so far as to say that 'the actual concept atom is irrelevant' to the development of the mechanical philosophy.³ Her insight, it seems, was extremely perceptive but she has made no attempt to explain why the ready-made matter theory of atomism was not taken up and has provided little evidence to back up her assessment. It is the aim of this chapter to provide some of that evidence and to explain why the matter theory of atomism was not adopted, except in the most equivocal way, by the new breed of mechanical philosophers.

The fundamental reasons for this avoidance of what might seem to be a convenient systematic treatment of matter theory are quite simply stated. Most obvious, perhaps, are the religious objections. Atomism was associated with Epicurus who was frequently condemned as the 'secretary of Hell' and as a lewd, immoral atheist.⁴ To adopt atomism as a natural philosophy, therefore, was to adopt a materialist philosophy which denied providence, freedom of the will, and other essentials of Christian doctrine. The rehabilitation of Epicurus began in the fifteenth century almost as soon as his writings⁵ and Lucretius' De rerum natura were rediscovered by Renaissance humanists,⁶ and continued, with the work of Gassendi and others, into the seventeenth century.⁷ Nevertheless, the taint of immorality and atheism was hard to remove, and even Gassendi's

own version of the atomist philosophy has fundamental differences from the Epicurian original.⁸ In order to avoid charges of atheism the seventeenth-century mechanists had to dissociate themselves as much as possible from the godless aspects of ancient atomism and to emphasise the providential and theistic aspects of their own natural philosophy. In so doing they developed a philosophy which differed in many respects from Epicurean natural philosophy. This aspect of the history of seventeenth-century science is well-known and we need not dwell on it here.⁹ Instead we will concentrate on the internal, strictly natural philosophical arguments which also militated against the acceptance of atomism, and which (surprisingly) have not received so much attention from historians. Once again the basic obstacles to an acceptance of atomism can be easily stated. Putting it simply, the two principles of ancient atomist matter theory - atoms and the void - were untenable in the seventeenth century almost to the point of being unthinkable. The arguments which had been raised against these two principles by Aristotle and his followers were so entrenched and had been indoctrinated into the minds of so many generations of university-educated men that they were virtually unassailable. As a result the mechanists never professed to explain phenomena in terms of 'atoms and the void' but spoke instead of 'matter in motion'. It is the contention of this thesis that even this rubric - 'matter in motion' raised metaphysical and physical

problems for seventeenth-century natural philosophers. Before turning to this, however, we must show why the principles of 'atoms' and 'void' were so untenable to the early modern mind. First of all, we must briefly consider the Aristotelian arguments against the atomist matter theory and then try to show the difficulties confronting those philosophers who wished to overcome the Aristotelian arguments.

1 Aristotle, atoms and the void

Aristotle's stratagem had been to attack atomism on two fronts. Firstly, he argued that the basic tenets of the atomists - atoms and void - were completely untenable. And secondly, he took each of the explanations of physical phenomena which the atomists claimed as triumphs for their system and tried to demonstrate their inadequacy.

What made the atom itself an untenable concept, according to Aristotle, was its indivisibility. There is only one self-consistent interpretation of 'indivisible magnitude' according to Aristotle and that provides no possibility of translation into physical terms, and so no valid heuristic ability. Any pronouncements about invisibly small particles which are physically indivisible simply because of their extreme hardness will not serve the turn, according to Aristotle, because they will be theoretically

divisible. A particle with size and shape cannot be truly atomic because the mind will be able to distinguish parts within it and will have theoretically divided the particle, ipso facto. The only alternative is to embrace a concept of infinitesimal - infinitely small - indivisibles. Such infinitely small particles, however, are tantamount to the dimensionless points envisaged by geometers. They have no size whatever and so cannot be said to have shape or any of the other physical attributes ascribed to atoms. These infinitesimals are completely vulnerable to the attack of Zeno of Elea that 'if what is had no size it would not even be'.¹⁰

Aristotle explains this difficulty with some care. If a magnitude were to be built up of a succession of atoms then these atoms would have to be placed contiguous to one another. But bodies are said to be contiguous when their extremities come together. As soon as we speak of 'extremities', however, we are distinguishing parts in our hypothetical indivisibles. The only way that two partless atoms could come together would be with respect to their wholes. In other words, they would be entirely coincident. It follows that no matter how many dimensionless points or atoms are brought together they can never accrue to form an object with dimensions.¹¹

Until recently classical scholars have been inclined to

suppose that Leucippus, Democritus and the other pre-Socratic atomists insisted upon atoms which were physically unsplittable but, on account of their finite size, theoretically divisible. In The history of Greek mathematics, for example, Thomas Heath simply declared that Democritus was 'too good a mathematician' to believe in indivisible geometrical magnitudes.¹² However, we can infer from Aristotle's rare admiration that Democritus was a good philosopher too, and the concept of an atom with finite size was fraught with philosophical difficulties for the Greek mind. It did nothing, after all, to dispose of the arguments drawn up by Zeno of Elea against the concept of infinite divisibility. As soon as Democritus admits that his atoms are theoretically divisible then he is no better off than any other pluralist philosopher confronted by Zeno's monism.¹³

As a result of very detailed considerations the two leading scholars on this aspect of Greek thought have concluded that Democritan atomism did involve theoretically indivisible atoms - that is to say infinitely small atoms. Moreover, this is certainly the view of Democritus which Aristotle took.¹⁴ At the same time we have to admit to inconsistency in the Democritan treatment: 'We are faced with the conclusion that Democritus believed there were minute particles of matter which were not merely unsplittable but also theoretically indivisible. Yet

they certainly had size and shape'.¹⁵ If the great ancient advocate of atomism fell into such entanglements it is hardly surprising that those who sought to revive it in the seventeenth-century found it an area of natural philosophy bedevilled by problems.

The second principle of the atomists: the void, was no less problematic for ancient and modern alike. In his Categories, Aristotle sketched out those circumstances which are required to describe or define an object. One of these was the object's position or place.¹⁶ Accordingly, Aristotle devoted a great deal of effort to a philosophical analysis of the concept of 'place' but there is virtually no discussion of the concept of 'space' in his works. This contingency forms a crucial aspect of the background to Aristotle's rejection of the void. The abstract concept of space, which is a familiar part of our mental furniture today, hardly appears at all in Aristotle. For him, it is meaningful to say that bodies have a particular position relative to one another. It is perfectly correct, therefore, to say that water is in a vessel but if you were to say that the vessel was in space Aristotle would be forced to deny this as nonsensical. Putting it at its simplest, Aristotle denies the concept of space because it conveys nothing: to say water is in a vessel is to provide information about its position, to say a vessel is in space is to say nothing.¹⁷

Aristotle defines 'place' as the 'limiting surface of the body continent - the continent being a material substance susceptible of movement by transference'.¹⁸

An empty or void place would, therefore, be absurd: 'an empty limiting surface of the non-body continent'. As is well known, this was held to be so absurd that it was preferable to suppose that even the strongest vessels would collapse rather than allow the formation of a vacuum.¹⁹

A further difficulty for Aristotle (which reveals just how alien to us his way of thinking on this topic was) was that a vacuum would seem to violate one of the major principles of natural philosophy: that two bodies cannot occupy the same place at the same time. He expresses his difficulty like this:

Now this yielding [of one body to another] is impossible in vacuity, which is not a material entity at all and one must suppose that the dimensionality already there in the place before it was occupied must interpenetrate the equal dimensionality of the intrusive cube when it enters; just as if the water or air should not make way for the wooden cube but should permeate it all through.²⁰

On the one hand Aristotle objects that the void is not material enough to be displaced by an encroaching object and on the other he objects that two physical, three-dimensional objects will be interpenetrating in one place. This seems to be one of the most important and (unfortunately) influential manifestations of what has been regarded as a general failure in Greek thought to

distinguish between corporeal and incorporeal.²¹

As well as his general points, Aristotle felt able to undermine atomism by showing that specific arguments proposed by the atomists were invalid. The major examples involve the phenomena of local motion. An extended void would necessarily provide an isotropic volume and so the concepts of 'up' and 'down', which are an important corollary of the Aristotelian concept of 'place', could have no immediate meaning. There would be no reason why it should not move any way at all.²² Furthermore, the unnatural motion of projectiles would be equally impossible without the continuous effect of the medium through which it was travelling.²³ Besides, the medium not only helps to propel projectiles it also influences the speed of bodies moving through it. The total lack of resistance to movement which is provided by a void must entail an infinite speed.²⁴ By these arguments Aristotle hoped to establish that the phenomena of local motion do not prove the existence of void, as the atomists had claimed, but rather prove that the void could not possibly exist.²⁵

Similarly, Aristotle insisted that the void need not be introduced to make sense of condensation and rarefaction. On the contrary, he believed that the atomist explanation was completely untenable. Any assumption that condensation

was caused by the coming-together of the constituent particles of a substance implies that the particles are initially at some arbitrary distance from one another. This involves the existence of what Aristotle calls 'self-determined voids'. The atomists can give no explanation of why a particular collection of atoms should stand off from one another in a rare body. There can be no escape by supposing the voids between particles to be determined by the way the particles are packed together. Admittedly, there must be empty spaces between close packed spherical particles but these voids cannot be filled up by compression or condensation (assuming that the particles are perfectly hard).²⁶

It should be clear from all this that Aristotle's approach to these problems is vastly different to the way we might approach them ourselves. In some cases Aristotle's way of thinking is so alien to us that our difficulty lies not so much in following his reasoning as in seeing where the problem lies. This was not so for the early modern thinker, however. Thanks to its predominance in the pedagogical tradition, the Aristotelian arguments still held sway over all but the keenest minds. Indeed, it is possible to show that even the most able of natural philosophers experienced great difficulties in trying to circumvent the Aristotelian objections. We will try

to illustrate this in the next two sections by considering a few salient examples.

2. Indivisible magnitudes and the new philosophy

Let us begin by considering the arguments of two of the greatest 'scientific' minds of the early modern period. Galileo Galilei (1564-1642) and his contemporary, the English mathematician, Thomas Harriot (1560-1621), seem to have recognised the explanatory power of the ancient atomist theories, and both men tried to develop a coherent concept of indivisible particles in order to explain various physical phenomena. For example, in his Discourses on two new sciences (1638), Galileo adopted atomistic theories in order to account for the impenetrability and cohesion of solid bodies. There are only two possible causes of coherence he claimed, 'one of which is the celebrated repugnance that nature has against allowing a void to exist' and the other is 'some sticky, viscous, or gluey substance that shall tenaciously connect the particles of which the body is composed'.²⁷ During the discussion the latter of these is dropped and Galileo relies exclusively on the former. It is at this point that he turns to an atomic interpretation of the structure of matter. For, although the cohesive force due to horror vacui is strong enough on a large scale to account for the difficulty of pulling apart two glass plates, it is not strong enough to account for the much greater cohesion of most bodies. If, however, it is assumed that the force operates between minute particles of the body and that it

is thereby multiplied, because there are an 'immense number' of such particles, then the observed strength of cohesion can be explained. However, as recent commentators have often been dismayed to realise, Galileo's atomism is by no means straightforward. For Galileo every body is composed of an infinite number of atoms. In fact, he is forced to say that a divisible magnitude cannot be constructed out of two or ten or a hundred or a thousand indivisibles, but requires an infinite number of them.²⁸ But why should Galileo take this, surely surprising, step?

In fact, it was largely as a result of his mathematical approach to nature that Galileo was led along this path. The Academician, as he called himself, 'according to his custom' demonstrated everything by geometrical methods.²⁹ By insisting on the validity of geometry for understanding the physical world Galileo was forced to preserve continuity as a sine qua non. An acceptance of finite indivisibles would have to mean the rejection of geometry. Galileo explains this quite simply: if three, five or seven indivisibles can be added together to make a divisible line then bisection of that line would involve bisecting the middle particle which, therefore, could not be indivisible. Galileo, excellent mathematician that he was, recognised the need to uphold infinite divisibility and so rejected the physical concept of finite atoms.

Similarly, Harriot also recognised the quandary and considered some geometrical problems which arise if a line is supposed to be made up of 'atoms', including the problem of incommensurability which defeated the Pythagoreans:

Another difficultie ariseth from the square. If a line be compounded ex atomis the diametrall line will be found to be equall to [commensurate with] the side.³⁰

Harriot promises to provide the solution to these problems but this promise remains unfulfilled in those of his manuscripts which have survived.³¹

Galileo seems to have progressed further since he was able to come up with a very elegant if not entirely convincing³² geometrical demonstration that a finite line could be composed of an infinite number of particles with an infinite number of vacua between them. This demonstration arises from a solution of the problem of 'Aristotle's wheel'.³³ The problem goes like this: how is it that a small circle, concentric to a larger one will roll out a line equal in length to the line rolled out by the larger one even though both circles have only made one revolution? (fig. 1) Galileo, working by analogy, shows that in the case of two concentric polygons, the sides of the inner polygon will not trace out a continuous straight line but will jump over parts of the line, so forming a line with gaps. (fig. 2) It follows, therefore, that a polygon of an infinite number of sides, that is to say a circle, can be made to trace

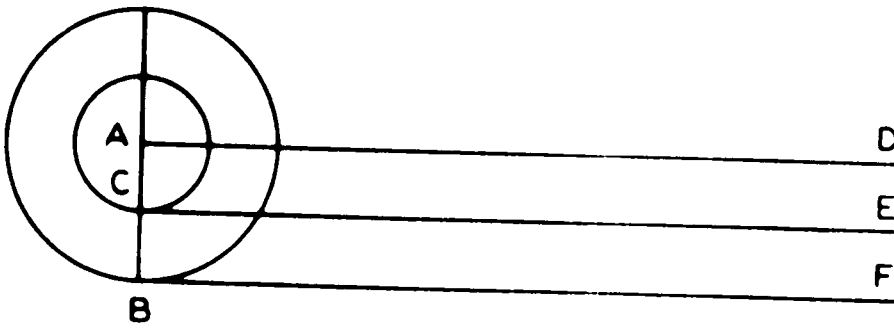


fig. 1

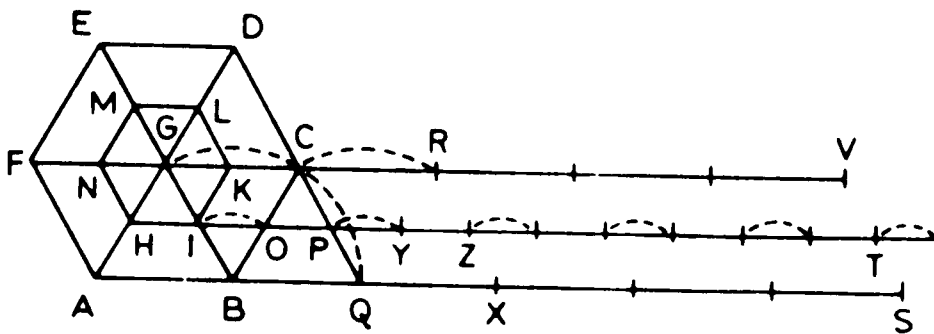


fig. 2

As the large hexagon $ABCDEF$ rolls about point B , point C will move along an arc to Q . The central point G will be raised in an arc above the line GV , only to return to the line at C . Similarly the side IK of the smaller hexagon will be lifted above the line IT and come back to it along OP as BC coincides with BQ . The line IO will be left empty.

out a line with an infinite number of points alternating with an infinite number of gaps or vacua. Galileo subsequently insists that this geometrical demonstration must be understood to hold also in the case of surfaces and solid bodies, which must be composed of an infinite number of atoms with an infinite number of vacua between.³⁴

It should not go unnoticed that although Galileo is using

the word 'atom' (atomi) he is essentially talking about geometrical points. Certainly, these are atomic in the sense that they are indivisible but they are clearly not the same as the atoms of Epicurus. Evidently Galileo is actually in agreement with Aristotle about the untenability of physical atoms and has, therefore, developed his own notion of 'mathematical', infinitely small atoms.³⁵ Similarly, Harriot tells us that although a finite line 'cannot have his partes of a finite magnitude but they must be of a finite number', it could have an infinite number of parts if it 'be understood to be compounded of poyntes'.³⁶ And like Galileo, he freely uses the word atomus even while talking about the infinitely small. For, example, he tells us that a circle is composed of an infinite number of atoms:

Seeing that every line is compounded ex atomis & therefore in the peripherie of a circle one atomus is succeeding one another infinitelie in such manner as that the peripherie is at last compounded & made.³⁷

It seems clear that both these thinkers, as a result of their knowledge of and respect for mathematics and geometry, had to accept that all quantity must be infinitely divisible, just as Aristotle had done before them. The only other route they could have taken would have been to try to develop a finitist or discrete geometry. But the problems involved in such a scheme seem to have been thoroughly daunting to all but those

with the most naively unmathematical minds. This can be clearly illustrated by considering two earlier thinkers: the Italian nature philosophers, Giordano Bruno (1548-1600) and Francesco Patrizi (1529-1597).

As a staunch and devoted Platonist, Patrizi wanted to defend his ancient mentor's belief in 'indivisible lines'.³⁸ So, when Patrizi confronted the difficulties arising from infinite divisibility of the sort we have just seen Galileo and Harriot considering, he showed no hesitation in rejecting the concept of infinite divisibility. Acceptance of this concept, he argued, would mean that the smallest line imaginable would be equal to an infinite line, and a part of a line would be equal to the whole because they could all be divided equally, namely infinitely. Similarly, Bruno argued that if everything were infinitely divisible then everything would be equal in size: the whole universe equal to the world, and the world equal to an apple.³⁹ Accordingly, Patrizi insists that lines are composed of finite indivisible lines.⁴⁰ Patrizi's Platonist priorities enable him to dismiss the absurdities which arise from his position as totally inconsequential in comparison to those arising from infinite divisibility. He admits that in the case of a triangle composed of three of these atomic lines it would be 'impossible' to drop a line from the apex perpendicular to the base because this would bisect the base line, but insists that this merely proves that

Geometry can only be applied when dealing with lines built up from several atomic lines (presumably in even numbers if they are to be bisected!).⁴¹

Neo-Platonic and Pythagorean preconceptions also led Patrizi and Bruno into absurd attempts to defend Pythagorean wisdom from the threat of incommensurables. If it can be established that all lines are composed of a finite number of indivisible lines it follows that the diagonal of a square, for instance, must be commensurate with its side. Bruno's efforts to save Pythagoreanism in this way provide a fascinating example of what Kurd Lasswitz refers to as Bruno's 'ingenious fantasy' (geistvolle Phantasie).⁴²

In the scholium to Book I, Chapter 7 of De minimo⁴³ Bruno objects to the Aristotelian argument (outlined above) that infinitely small indivisibles cannot build up to form a finite object.⁴⁴ Bruno attacks this by insisting upon a distinction which, he feels, Aristotle has failed to observe. Bruno insists that the terminus or boundary of a minimum is not a part of that minimum but is simply a necessary logical adjunct to the concept of body. It is possible, therefore, for the termini of two bodies to come together without any increase - these termini, having no parts, do absorb one another as Aristotle would have predicted. However, the minima, the indivisibles themselves are kept apart by their

termini.⁴⁵ Now, this strategy seems at first sight to be superfluous effort (one might even say sheer futility) because Bruno has already established that atoms are not infinitely small (i.e. without parts) but are finitely small spheres. Bruno, it seems, has completely missed the point of Aristotle's argument. He could have taken the much more straightforward line, like Epicurus, of insisting upon the hardness of his finite atoms to prevent their absorption or conglomeration into one another. What, then, is Bruno trying to do?

The answer is simple but astounding. Bruno is not content with a concept of an atom which is physically indivisible on ad hoc grounds. He wishes also to establish that it is indivisible in every sense, and that mathematicians and logicians are as wrong to believe in the concept of infinite divisibility as scholastic natural philosophers. Bruno is so unsympathetic to mathematics that if it does not coincide with his physics he believes it to be untenable. By making the distinction between the minimal part and the terminal non-part (terminus ergo est qui nulla est pars, et per neque minima pars)⁴⁶ he believes he has undermined Aristotle's mathematical argument and has opened the way for a geometry of discretes.

We need not pursue Bruno's elaboration of his concept of terminus; suffice it to say that it is granted the partless

status of Aristotelian points, leaving Bruno free, so he thinks, to regard his atoms as the true primary principles of geometry. No one has ever begged a question to quite such an extent. When he argues that his two spherical atoms do not touch at a part of each other but at their partless termini, he is merely affirming for the reader that two spheres touch at a dimensionless point, and the surface of a sphere (or the circumference of a circle) can be analysed, therefore, into an infinite number of such points. As Paul-Henri Michel puts it: 'this doctrine presents while it denies (and in the very moment of denying) the concept of the infinitely divisible'.⁴⁷

Even so, Bruno goes on to use his discrete geometry to reject the argument that the diagonal of a square is always incommensurable to the side. The seeming incommensurability is merely an illusion, Bruno claims, brought about by the mind's tendency to create perfect figures out of the true minimal figures.⁴⁸ If we bear in mind that a true square is built up from an even number of spherical atoms then we can see with the aid of a diagram that the diagonal will always consist of an equal number of atoms to the side (fig. 3).⁴⁹ The mind deceives itself into notions of incommensurability when it fails to realise that the atoms touch each other along the sides but do not touch along the diagonal.⁵⁰

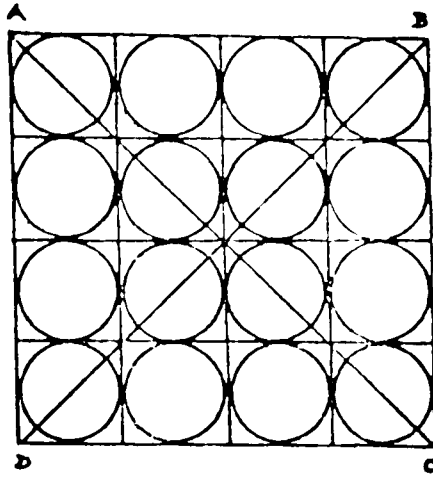


fig. 3

Patrizi and Bruno could hardly have been so cavalier in sacrificing mathematics to their metaphysical and physical preconceptions in these ways had they not been almost entirely insensitive to the systematic, logical coherence of geometry and mathematics. Their finitist geometries had no subsequent influence that I am aware of. Certainly, they were not followed by mathematical philosophers like Galileo and Harriot. For those who respected the demands of mathematical procedure and, one might even say, the demands of normal rational discourse,⁵¹ Aristotle's arguments against indivisible magnitudes proved insurmountable. Galileo's theory of indivisibles, accordingly, appears as an ultimately unsatisfactory compromise while Harriot's efforts to revive atomist notions remain disjointed, incomplete and inadequate among his unpublished papers.⁵²

In view of these difficulties it is hardly surprising that the mechanical philosophers tended to agree with Aristotle

that matter was infinitely divisible. The word 'atom' often appears in the writings of seventeenth-century mechanists but it is always used loosely.⁵³ When being more careful mechanical philosophers chose instead to write of corpuscles or minima naturalia.⁵⁴ Robert Boyle, to name just one example, reconciles Cartesianism and Atomism because both philosophies explicate 'things by corpuscles, or minute bodies' and subsumes them both under the heading of 'corpuscular philosophy'. While elsewhere he chooses to fall back on the even less controversial and thoroughly traditional designation of the 'minute parts' of bodies as minima naturalia.⁵⁵

3. Void space and the new philosophy

The Aristotelian arguments against the other atomist principle - nothingness or void - proved less intractable than those against indivisible magnitudes but even so the story is a long and complex one. In a very real sense this story is inextricably bound up with the development of the modern world-view and it would divert us way beyond the bounds of this thesis to pursue all the threads here. For example, when thinkers like Galileo and Descartes wished to produce a new inertial theory of motion and to replace the Aristotelian belief that omne quod movetur ab alio movetur, they were able to draw on kinetic theories opposed to Aristotle's dating from at least as early as the sixth century.⁵⁶ Many of these earlier

impetus theories of motion were developed in response to Aristotle's arguments about the impossibility of motion in a vacuum and appeared as digressions in arguments to establish the possibility of void space.⁵⁷

Moreover, as Edward Grant has convincingly shown, the philosophical possibility of space empty of body was always bound up with theological problems about God's omnipotence and his relationship to the world.⁵⁸ The resulting theological demand for the possibility of or even the necessity for void space remained a lively topic of debate well into the seventeenth century, as can be seen in the works of Henry More (1614-1687) and Isaac Newton (1642-1726).⁵⁹ These two Englishmen and the Frenchman, Pierre Gassendi (1592-1655), were largely responsible for introducing the concept of space as an absolute, three dimensional but immaterial entity into the mainstream of European thought. In view of the eventual longevity of their concept of space and its near unanimous support by natural philosophers until the twentieth century it can hardly be denied that they succeeded in overcoming Aristotle's objections to the concept of void space. The history of this triumph over Aristoteleanism has been amply dealt with in a number of books and articles and we need not go any further into it.⁶⁰ However, it should not be forgotten that Descartes, Hobbes

and other contemporary mechanical philosophers rejected the concept of void space as completely insupportable.

The most familiar and perhaps the most important example of a plenist mechanical philosopher is René Descartes. His metaphysics led him to define body exclusively in terms of extension (res extensa), so the very idea of extension without body was self-contradictory. Although Descartes presents his arguments in an entirely original way, fundamentally they are based on age-old Aristotelian assumptions that three dimensional extension can only be predicated of an extended something and that something must be body.⁶¹ Moreover, the whole of Cartesian physics, like Aristotelian physics, required an uninterrupted succession of bodies in all directions, since the sequence of cause and effect could only be transmitted by contact action.

Thomas Hobbes did not accept the Cartesian identification of matter and extension because, as he himself put it, 'extension is one thing and the thing extended another'.⁶² Nevertheless, he too was a committed plenist and his essentially Aristotelian approach to the concept of space and place is obvious from even a cursory glance at his discussion in De corpore.⁶³ Like many a scholastic philosopher before him Hobbes dismisses the concept of empty space merely as 'imaginary', a 'phantasm' which

only becomes real space when it is co-extended with the magnitude of a body.⁶⁴

Perhaps the final testimony to the continued vigour of the Aristotelian arguments against void space is provided by Robert Boyle. Although Boyle performed many elegant experiments with his renowned air-pump, he never unequivocally committed himself to the existence of a vacuum within his pump. Writing in 1670 he felt bound to apologise for his free and easy use of the term Vacuum Boylianum 'because, to call it vacuum absolutely, would be judged by many a declaring himself a vacuist, who does not yet own the being either of their opinion, or a downright plenist'.⁶⁵

Boyle's equivocation is fully in keeping with his habitual cautious scepticism but it is also an indication of Boyle's awareness of the philosophical difficulties confronting the notion of vacuum.

One of the greatest stumbling-blocks which Aristotle had presented to atomism was his insistence that the atomist account of condensation and rarefaction implied the existence of 'self-determined voids'.⁶⁶ The cogency of the Aristotelian arguments are superbly illustrated by the Aristotelian mechanical philosopher, Sir Kenelm Digby (1603-1665). Digby is quick to acknowledge the elegant simplicity of the atomist account, in which rarefaction is defined merely in terms of an increased distance

between the constituent particles of the body. The problem, of course, is that some means of holding the particles apart from each other must be found. Calling upon the researches of Galileo and the fifth century neo-Platonist, Marinus Ghetaldus, Digby points out that gold is 7,600 times heavier than air.⁶⁷ If all matter qua matter is uniform in weight, then this difference in weight can only be explained by the fact that there is correspondingly less matter in a volume of air equal to a volume of gold.⁶⁸ It follows that the 'body of air' must 'appeare to be like a net, whose holes and distances are to the lines and thriddes in the proportion of 7,600 to one'. The proportion of vacuity to matter on this assumption is too absurd to be admitted, or so Digby believes. Furthermore it seems to deny the very nature of rare bodies which are generally judged to be fluid:

If such vacuities were the cause of rarity, it would follow that fluide bodies being rarer than solid ones, they would be of themselves standing, like nettes or cobwebbes: whereas contrariwise, we see their natures are to runne together, and to fill up every little creek and corner: which effect, following out of the very nature of the things themselves, must needes exclude vacuities out of that nature.⁶⁹

This was to prove an insurmountable problem until Newton simply cut the Gordian knot by postulating the existence of repulsive forces acting at a distance between the particles of bodies.⁷⁰ The fact that Newton could only

circumvent this problem by denying one of the major precepts of the mechanical philosophy - that action does not occur over a distance - is a sure testimony to the vitality of the Aristotelian arguments.⁷¹

4. Matter in motion: the problems resolved?

In conclusion, therefore, we can say that Aristotle left a legacy not only of doctrine but also of heuristic, which prescribed the way in which the problems associated with indivisible magnitudes and void space were approached. The result was that the concept 'atom' with its clear implications of indivisibility tended to give way to a much more amorphous concept - the corpuscle. Likewise, arguments about the existence or impossibility of void spaces were not allowed to interfere with the development of the mechanical philosophy as a new and pragmatic way of understanding the workings of the world. In a sense, therefore, the mechanical philosophy developed independently of arguments concerned with 'atoms and the void'. The ancient principles of atomism were indeed, as Marie Boas Hall has said, virtually irrelevant to the development of the new philosophy. The rubric which summarised the new Weltanschauung was 'matter in motion'. This phrase was superficially unproblematic. It would not excite reactions of incredulity or even contempt from the lay audience for natural philosophy the way the phrase 'atoms and the void' undoubtedly would. However, as soon as the details of the mechanical philosophy began to be

worked out, a whole series of crucial new questions had to emerge. Where does the motion come from? How is it preserved? Is it innate in matter? Is it perhaps supplied by an immaterial active spirit? If so, what can we learn about the nature of this active spirit? The list could easily be extended.

Hitherto, questions like these, regarding the nature of activity in the world, have been seen by historians of English science as unique to Cambridge Platonists, like Henry More and Ralph Cudworth, and to Isaac Newton.⁷² Certainly these three men were explicit in their denial of the strict mechanical account of nature in which the amount of motion in the world was constant and merely transmitted and transferred by successive impacts between bodies. Newton, for example, foresaw a number of problems in this view:

If you think that the vis inertiae is sufficient for conserving motion, pray tell me the experiments from whence you gather thy conclusion. Do you learn by any experiment that the beating of heart gives no new motion to the blood, that the explosion of gunpowder gives no new motion to a bullet or that a man by his will can give no new motion to his body? Do you learn by experiment that the beating of your heart takes away as much motion from something else as it gives to the blood or that explosion takes away as much motion from something else as it gives to a bullet or that a man by his will takes away as much motion from something else as he gives to his body? If so, tell me your experiments; if not your opinion is precarious. Reasoning without experience is very slippery.⁷³

As a result of such obvious divergence from Descartes, Newton has come to be seen as fundamentally different from other mechanical philosophers. It has even been noticed that Newton was so far from being a mechanical philosopher in the accepted sense as to have declared: 'We cannot say that all nature is not alive'.⁷⁴ Similarly, the Cambridge Platonists, with their vigorous rejection of Hobbes, and Epicurus, and their superimposition of a hylarchic principle onto the Cartesian philosophy, have also been regarded as far removed from mechanism.

It is my contention in this thesis that, contrary to what has usually been supposed, the gulf is not so wide between Newton and the Cambridge Platonists on the one hand and those who are considered to be straightforward mechanists on the other. In the following chapters I hope to be able to show that metaphysical problems about the source of the perpetual motions and activities in nature are never far from the minds of all the major English exponents of the mechanical philosophy. The Cartesian suggestion, that there is no new motion in the world because the amount of motion has remained constant since God gave an initial push at the Creation, gained no fully-committed adherents in England. All of the major figures in English mechanical philosophy rely to some extent on some form of active principle.⁷⁵

Even the Yorkshire philosopher, Henry Power (1623-1668),

who is frequently regarded as one of Descartes' most devoted English followers, seems in fact, to have believed that matter was inherently active. Perhaps this is most clearly highlighted by comparing this so-called Cartesian with the outrageous freethinker and vitalist philosopher, John Toland (1670-1722). Toland's insistence, in 1704, that 'matter is necessarily active as well as extended',⁷⁶ is indistinguishable from Power's belief, recorded in 1661, that motion 'is as inseparable an attribute to Bodies, as well as Extension is'.⁷⁷ Similarly, Toland's doctrine that 'all the matter in Nature, every Part and Parcel of it, has bin ever in motion and can never be otherwise', may be directly compared with Power's rhetorical question: 'is it not probable that Motion also may be indefinitely swift or slow, and yet never come to a quiescency? and so consequently there can be no rest in Nature, more than a Vacuity in Matter'.⁷⁸ It would seem that for Power no less than for Toland 'motion is essential to matter'.⁷⁹ It may well be argued that the difference between the two men lies in the fact that Power hoped to find a strict mechanical account of his incessant motions. There is, however, no evidence for this. Although he promised, in the Preface to his Experimental philosophy, to deal with the problem of motion 'in another place',⁸⁰ as far as we know he did not. We can only conclude that he found the endeavour too daunting. As he said,

'the Speculation of Motion, and its Origin [is], as I conceive one of the obscurest things in Nature'.⁸¹

The 'mechanical philosophy' does not begin with Henry Power, however. In order to establish our case we must begin at the beginning and proceed to the demise of the mechanical philosophy - when active principles emerge triumphant in the philosophy of Newton. If we are to begin with the very first efforts to explain the phenomena of nature in terms of 'matter in motion', then we must look to the 1630s when, inspired by his discovery of Euclid and Galileo, Thomas Hobbes turned from classical studies to natural philosophy.⁸²

CHAPTER 2

THE NON-MECHANICAL ORIGINS OF THE MECHANICAL PHILOSOPHY:

THE BACKGROUND TO HOBBS' LITTLE TREATISE

It is usually accepted that a short manuscript tract written by Thomas Hobbes in the 1630s is the earliest contribution by an English thinker to the mechanical philosophy of nature. Hobbes entitled this manuscript 'A short tract on first principles' but it is more usually known as The little treatise.¹ The foremost student of Hobbes' mechanical philosophy, Frithiof Brandt, has argued that 'the germ of the mechanical conception of nature is found in this treatise' and has therefore insisted that 'this treatise is Hobbes' most important work on natural philosophy'.² Accordingly, Brandt has provided a detailed and penetrating study of The little treatise in his yet to be superseded study of Thomas Hobbes' mechanical conception of nature. However, there are one or two extremely significant aspects of Hobbes' 'Short tract' which Brandt failed to elucidate. In particular, Brandt was unable to determine any significant influences upon Hobbes' new way of thinking and was forced to come to a somewhat romantic conclusion which is rather unsatisfactory to the historian:

When Hobbes' interest in philosophy was re-awakened by the problem of the act of sense, and the idea of motion 'forte fortuna' occurred to him, the babe of thought leaped in him as Kirkegaard would say; at that moment he was a genius.³

Moreover, try as he might Brandt could not understand Hobbes' theory of motion. Hobbes' discussions of objects with 'inherent power to move' seemed to Brandt to be 'a singular concept' which 'remained obscure'.⁴ It is the purpose of this chapter to extend Brandt's studies and to suggest answers for these two problems. In order to be able to understand the second problem - the nature of Hobbes' concept of bodies or agents with 'inherent power to move',⁵ - we must first know something about the sources from which he drew those ideas. We turn first of all, therefore, to a consideration of the influences upon Hobbes, during the earliest phase of his career as a natural philosopher.

1. Thomas Hobbes' early influences

We can be certain that Hobbes wrote The little treatise before October 1636. For, at that time he wrote a letter in which he upholds a mediumistic theory of light transmission. At this stage he admits that his speculations are incomplete but he is nevertheless adamant that light is merely a motion in the medium surrounding all bodies.⁶ Hobbes never again changed his opinion on this matter and so we can be fairly certain that The little treatise, which relies upon a corpuscular theory of light, belongs to a period before this date. Ferdinand Tönnies and Frithiof Brandt argue that the most likely date for the composition of

these 'First principles' is 1630. The evidence for such an early date, however, is far from straightforward. In order to defend himself from charges of plagiarism, levelled at him by Descartes, Hobbes wrote to Mersenne that he explained his theories about 'the nature and production of light' to William and Charles Cavendish 'in the year 1630'.⁷ Five years after writing this letter, in 1646, Hobbes actually wrote a short optical treatise which he evidently hoped to publish. In the intervening years Hobbes could hardly have forgotten the earlier charges of plagiarism and so it comes as no surprise that he inserted an oblique reference to the antecedents of the ideas presented and their date. In the dedicatory epistle, therefore, he wrote:

That which I have written of it [optics] is grounded especially upon that wch about 16 yeares since I affirmed to your Lo^{PP} at Welbeck, that light is a fancy in the minds, caused by motion in the braine
.....⁸

The veracity of these claims is undermined slightly, I feel, by the fact that Hobbes is disingenuously concealing the fact that the theory of light presented in The little treatise is very different from the views which he developed after October 1636. After 1636 his theory did suddenly become mediumistic and much closer to Cartesian ideas than anything in The little treatise.

In view of the undeniably bitter rivalry between Hobbes

and Descartes I think it is unsafe to take Hobbes' claims about the early date of composition as totally reliable. Furthermore, in his autobiography he quite clearly states that 'he began to investigate the principles of natural science' while on his third visit to Paris during the tour he made between 1634 and 1636.⁹ It would seem from this that the earliest date for the composition of The little treatise is 1634. Brandt's efforts to extend this terminus a quo back to 1630 by an over-scrupulous reading of Hobbes' autobiographical writings do not affect this conclusion.¹⁰ All Brandt succeeds in doing is arguing that before he began to write Hobbes must have already been thinking along 'mechanist' lines. But what then or who was the inspiration for this new way of thinking?

Brandt considers the influence of Francis Bacon, whom he regards as a proto-mechanist, and Galileo but finds little in Hobbes' earliest philosophical work which bears the unmistakable imprint of either thinker.¹¹

Hobbes himself tells us of the stimulating effect that Euclid's Elements had upon him but this influence extends only as far as Hobbes' method and cannot be said to have inspired his mechanical philosophy in any detailed way.¹²

Brandt seems rather to regard Aristotle as the major influence on Hobbes.¹³ There is a great deal of truth in what Brandt says and it should be recognised as a

further indication of the prolonged influence of Aristotle even upon leading thinkers of the so-called 'Scientific Revolution'.¹⁴ Nevertheless, the Aristotelian aspects of Hobbes' early work are matters of method and approach. We can still find nothing to help us explain the details of Hobbes' mechanical philosophy as he unfolds it. It is this which led Brandt to emphasise the creative nature of Hobbes' Little treatise and see it as 'the babe of thought' leaping in Hobbes' mind.

Some of Hobbes' contemporaries were rather more cynical and, it must be admitted, somewhat less sympathetic to Hobbes' genius than Brandt. John Wilkins and Seth Ward do not confine themselves to speaking of 'influence' but insist that Hobbes' Little treatise is a work of plagiarism. So far, these accusations have received virtually no attention from scholars. They have tended to be dismissed merely as further examples of the vilification heaped upon Hobbes as a result of what were taken to be his atheistic principles.¹⁵ However, if we take these accusations seriously for a moment we are led to examine the manuscript papers of an early but scarcely remembered associate of Hobbes, Walter Warner (1570-1642/3). For it is he who was singled out by Seth Ward as the major 'influence' on Hobbes:

That which he [Hobbes] so much glories in, is not his owne invention, but is contained for substance

(as I am certainly informed by one who hath seen it) in Mr Warners Papers, which Mr Hobbs had long since in his hands¹⁶

Walter Warner was one of the three magi. That is to say he was one of the three 'wise men' who, so we are told by John Aubrey and Anthony Wood, helped the so-called 'wizard earl', Henry Percy (1564-1632), ninth Earl of Northumberland, to pass the time while he was imprisoned in the Tower.¹⁷

The wizard earl's three magi or three pensioners were Thomas Harriot (1560-1621), Robert Hues (1553-1632) and Walter Warner.¹⁸ So far Warner has failed to excite much scholarly attention. In comparison with his close friend Harriot, for example, the amount of work on Warner is virtually negligible, and yet it seems to me that he is at least as interesting as Harriot.

What makes Warner so interesting is that he did leave substantial remains about a carefully thought-out system of natural philosophy - something which Harriot never did¹⁹ - and this system alone deserves much closer scrutiny than it has received so far.²⁰ I will give a brief outline of Warner's system here but first I will try to establish the clear similarities between Hobbes' Little treatise and Warner's philosophy.

Hobbes knew Warner very well. They were both members,

for a time, of the so-called Welbeck Abbey circle which clustered around William Cavendish, Earl of Newcastle, and his younger brother Sir Charles.²¹ Furthermore, there are strong indications that the two men were rivals in natural philosophy. This rivalry is made most explicit in a letter from Hobbes to William Cavendish written in August 1635 where it becomes clear that both men were engaged upon psychological studies. Hobbes wrote:

For the soule I know he has nothing to give your Lordship any satisfaction. I would he could give reasons for the facultyes and passions of the soule, such as may be expressed in playne English, if he can; he is the first, that ever I heard of, could speak sense in that subject. If he cannot I hope to be the first.²²

It is clear from this not only that Hobbes knew what Warner's opinions were on these matters but also that he approved of them to a large extent. As Hobbes deals with 'the facultyes and passions of the soule' in The little treatise we have every reason to suppose that he felt this was his own attempt to be 'the first' to 'give reasons' for them. It is fitting, therefore, to compare these aspects of The little treatise with the corresponding discussion in Warner's papers. To this we now turn.

The starting point for the third and final section of The little treatise is the problem of how animals move. This constitutes a major problem for Hobbes because he

has previously insisted that 'Nothing can move itself'.²³ Hobbes' opening gambit in Section III, then, is to presuppose that there are 'Animal spirits ... which are the instruments of sense and motion'. Now, according to Hobbes' earlier conclusions (remember he is imitating the method of Euclid)²⁴ if these 'animal spirits' are responsible for moving the body they must do so either by some inherent power or by virtue of passing on a motion which they have received from outside the body.²⁵ If animal spirits had inherent power to move, however, it would be impossible for any animal to stop moving because 'The Agent that moveth by Active power originally in it self, applyed to the patient, shall always move it'.²⁶ As animals can remain at rest,²⁷ it follows that the animal spirits merely transmit motions which they receive from external stimuli.

We find essentially the same argument in Warner's papers. While trying to explain the operations of the standard Galenic notion of 'locomotive faculty' Warner insists that the animal cannot be 'automaticall or self-motive without a distinct principium movent because absolutely such there can be none'. Furthermore the 'principium movent' cannot be an inherent power because the animal would then be condemned to move incessantly:

the principium by which it is activated is not connatural with it or so internally coniunct or connected unto it or dependent on it that it must necessarily and perpetually and invariably move ...

Warner concludes that because the activating principle brings about motions that are variable and occasional it must receive motion itself from an external and independent source.²⁸

Hobbes' animal spirits and Warner's locomotive faculty are both held to be activated by the effects of the various bodies in motion which impinge upon the animal body and transmit their motions through the animals sense organs. Hobbes puts it succinctly:

Light, colour, heat and other proper objects of sense, when they are perceived by sense are nothing but the severall actions of External things upon the Animal Spirits by severall Organs ...²⁹

However, the operation of external things upon the senses and then, in turn, upon the animal spirits to bring about local motion is not envisaged in crudely mechanistic terms of impact and recoil. As Warner is quick to point out, to 'imagine the activation of the locomotive faculty to be by corporall compulsion' is clearly absurd.³⁰ Hobbes too is fully aware that an object impinging upon our sight, for instance, may sometimes cause us to move and sometimes not. Similarly, we can be, indeed often are, moved by the memory of a thing which is not actually present.

Accordingly, both men introduce the concept of appetite

to play an intermediary role between sensory in-puts and the locomotive faculty (or animal spirits). Animal motion, when it occurs, is brought about by a complex chain of reactions. For Warner:

The locomotive faculty cannot be activated but by way of appetition or by the intervention and preactivation of the appetite or faculty appetitive and not possibly otherwise. And the appetite cannot possibly be activated but by some motion or cognoscitive object presented to it.³¹

While for Hobbes an external object is the efficient cause which acts upon the appetite or 'the act contrary to the Act of Appetite' which in turn sets up 'a motion of the Animal Spirits towards [or away from] the object that moveth them'.³² Appetite and its opposite also provide both men with working definitions of what is signified by good and bad - which both men choose to refer to in Latin: bonum and malum.³³

In order to explain how it is that the animal spirits or the locomotive faculty may be moved one way or another even in the absence of a bonum or a malum the two men have to address themselves to the problem of memory and the imagination. Hobbes refers to the inhabitants of memory and imagination as 'phantasma', Warner calls them 'fantasmes'. According to Hobbes 'a Phantasma is an action of the Brain on the animal spirits by the power it receiveth from external sensible things'. While he looks at a man, Hobbes says, he sees a man but when his eyes are closed or averted what he sees is the

phantasma of a man. Or, as Warner puts it: 'as the fantasme is but the continuation of the original sensible passion after the object is gone, so the fantasy is but the continuance of the sense'.³⁴ The next problem for Hobbes and Warner is to explain how the brain can summon up 'the effect [of the senses] after the cause is gone', and even after 'interpolation or intermission of quiet'.³⁵

Once again both come up with essentially the same answer.

This is how Hobbes deals with it:

The Act of Understanding is a Motion of the Animal Spirits by the Action of the brayne, qualified with the active power of the externall object.

We are said to understand a thing when we have the Phantasma or Apparition of it; but a Phantasma is the action of the brayne qualified on the Animal Spirits ... Corollary - Understanding (as a power) is a passive power in the Animal Spirits to be moved by the action of the brayne qualified.³⁶

Warner, using the old-fashioned terminology for the brain as 'the organ of the spirits sensitive' puts it like this:

the maner of the causation of these impressions or figurations by the action of the object and alteration of the spirits with their reception in organs seu subiecto sensitivo and the retention of them after the recesse of the cause imprimant is nothing els but a kind of habituation of the said organ sensitive And the faculty sensitive after the originall impression is made, that is

after his subiect or organ, if habituated, in all succeeding acts of fantasiation may be said operari or pati or movere ex habitu ... it being thus concluded and resolved on that the maner of retention of the original impressions of sensation is by way of habituation of the faculty sensitive, that is by a certaine fixed or permanent figuration or information of the subiect or organ of the spirits sensitive.³⁷

For both Hobbes and Warner, therefore, an idea can be 'called up', as it were, because the brain has been 'qualified' or 'habituated' or given a 'permanent figuration' in such a way that it can generate these ideas in the animal spirits.

Such changes in the brain are evidently brought about by the action of earlier sensory 'in-puts'. Hobbes illustrates his 'qualification' of the brain with an interesting analogy:

Though it may be doubted how the brayne can receive such power from the externall object; yet it is no more, nor otherwise, than when steale touched by the Loadstone receiveth from it a Magneticall virtue, to work the same effects the Loadstone itself doeth.³⁸

Walter Warner, writing a much more comprehensive account of natural philosophy than Hobbes' Short tract on first principles recognises the need to explicate his notion of 'habituation'. However, he decides to postpone this elucidation, but not before drawing the same analogy as Hobbes:

It may suffice for this time to have noted this much concerning the habituation of our faculties as well sensitive as Locomotive. But the maner of habituation in generall is also to be considered. And how some things are altered and do acquire a fixed and permanent quality as well by one act as by a thousand, as iron by one touch of the magnet, others do require many consuetudinary acts³⁹

It should be clear from all this that Warner's papers and Hobbes' Little treatise contain such remarkable similarities that the suggestion of influence can hardly be denied. I have concentrated here on the last section of Hobbes' Little treatise partly because it is in that section that Hobbes discusses 'the facultyes and passions of the soule' which he knew Warner to be concerned with.⁴⁰ Moreover, it is in this section that we can find similarities with Warner's vocabulary and words like appetite, phantasma (or fantasme), bonum and malum appear with their fairly specialised meanings, and so help to underline the similarities. Nevertheless, there is very little in the first two sections of Hobbes' Little treatise which could not also have been taken from Warner's papers. In spite of the very different presentations (Warner discursive and verbose, Hobbes brief and elliptical) the similarity of concept and argument remains marked. There are even similarities between Warner's papers and the final published version of Hobbes' De corpore (1655). Both men, for example, denounce the Aristotelian concept of materia prima as 'a vaine terme' (Warner) or 'a mere name' (Hobbes), but immediately recant to admit the usefulness of the concept as an 'abstract consideration of matter' (Warner) or 'body considered universally' (Hobbes) so that form or any accidental qualities need not enter 'into argumentation' (Hobbes).⁴¹

The notion of 'habitation' as it appears in Warner's

papers also appears in De corpore and Hobbes' well-known but little understood concept of conatus - usually believed to derive from Descartes - can also be found in Warner's work.⁴²

Having looked at Warner's papers, then, I feel bound to endorse the words of John Wilkins:

Though Hobbes for his part may think it below him to acknowledge himself beholding to Mr Warners Manuscripts, yet those amongst us who have seen and perused them must for many things give him the honour of precedency before Mr Hobbes.⁴³

Once the influence of Warner upon Hobbes is accepted we can use Warner's basic principles to help us to interpret and understand Hobbes' preconceptions when he wrote The little treatise. Before turning to this, however, we must first consider further influences upon Hobbes which have come to light since Brandt wrote his pioneering study.

The Italian scholar, Arrigho Pacchi, has recently unearthed, among the Hobbes manuscripts at Chatsworth House in Derbyshire, a list, drawn up by Hobbes himself, of several selected titles from the manuscript library of Sir Kenelm Digby.⁴⁴ We know this is a very select list because Digby donated his collection to the Bodleian Library and a complete list has been preserved. Hobbes' select list is dated 1634 and was made, Pacchi suggests, before the collection left Digby's possession.

The exact significance of this list must always remain uncertain but it is surely safe to assume that they represent works in which Hobbes was particularly interested. Now, this list is comprised mainly of works by Robert Grosseteste (d. 1253) and Roger Bacon (1214?-1294) but also includes a number of works from the neo-Platonic tradition, notably works by Hermes Trismegistus and Proclus.⁴⁵ It also includes an Arabic work of profound influence upon Grosseteste and Bacon themselves: Al-Kindi's De radiis stellarum.⁴⁶ Since Pacchi published this list, another Italian scholar, Aldo Gargani, has pointed out that Hobbes' Little treatise is heavily indebted to the works of Grosseteste and Bacon.⁴⁷

The clearest signal of the influence of Grosseteste and Bacon upon The little treatise is Hobbes' doctrine of 'species'. Hobbes' short work sets the scene for subsequent mechanical systems of philosophy by relying upon a corpuscular concept of matter. Hobbes refers to these corpuscles as 'species':

Every Agent that worketh on a distant Patient, toucheth it, eyther by the medium or by somewhat issueing from it self, which thing so issueing lett be call'd Species.⁴⁸

The concept of 'species', albeit in a rather different form, was first developed by Grosseteste and Bacon. Indeed, one of Bacon's most important works, which naturally appears on Hobbes' list of manuscripts, is entitled De multiplicatione specierum.⁴⁹

Hobbes' choice of the designation 'species' for his corpuscles is by no means simply a whim. Nor can it be seen as merely an attempt to avoid using the term 'atom'.⁵⁰ Simply by introducing the concept of 'species' into his Short tract on first principles Hobbes is assimilating into his natural philosophy a number of preconceptions without which his system could not operate. In order to understand this we must turn now to consider in detail Hobbes' early matter theory. In particular we must try to reach an understanding of Hobbes' belief in agents with 'inherent power to move' which Brandt found so unintelligible.⁵¹

2. Hobbes and 'The Agent that hath active power inherent in itself'

At the outset of The little treatise Hobbes lists the principles of causality - of which he distinguishes sixteen. From these principles he proceeds to draw conclusions. Two of these conclusions seem to allow for inherent power within bodies. The eighth conclusion reads:

The Agent that moveth by Active power originally in itself, applyed to the Patient, shall always move it.⁵²

And the fifteenth reads:

The Agent that hath active power inherent in itself, applyed to severall equal Patients, shall worke on them equally.⁵³

The nature of these agents is otherwise left obscure. The only other information we are given about them is that they have power in themselves 'to produce ... species', and because this power is inherent it follows (from the eighth conclusion) that 'Agents send out their species continually'.⁵⁴ I believe that we can only fully understand the intellectual background to these remarks by considering the similar concepts proposed in those thinkers whose work we have just shown to be influential upon Hobbes. Let us consider first the basic principles of Walter Warner's natural philosophy.

Warner's natural philosophy is based on four metaphysical principles: time, space, matter and vis. The demands of his ontology are delivered under the heading 'Of states, alterations, causes'.⁵⁵ The concept of existence he tells us, necessarily involves the concepts of time and space. If an object exists it must exist in time and space: 'The state of being or existence of a thing is the continuation of the being thereof in and for a certain time and space'.⁵⁶ Time and space themselves are, of course, exceptions to this - they must exist but they cannot be said to exist in time or space (to avoid infinite regress).⁵⁷

Warner's definition of time in terms of duration rather

rather than in terms of matter in motion marks a radical departure from the Aristotelian definition.⁵⁸ Similarly, in a section on 'Spacium, Locus, Ubi', Warner gives a definition of space completely at odds with that of Aristotle. Space is said to be the 'universal vessel or receptacle of things' and is described as continuous, eternal, immoveable, homogeneous, absolutely penetrable, and without solidity or resistance.⁵⁹ Even these few opinions are sufficient to indicate the major influence on Warner's ideas. These notions are entirely characteristic of neo-Platonic thought. Aristotle denied any absolute status to time and space, regarding them as sufficiently defined in terms of the motion or position of body.⁶⁰ The insistence upon the absolute nature of time and space is characteristically neo-Platonic. Plato himself referred to space as the 'Receptacle - as it were, the nurse - of all Becoming'.⁶¹ While early neo-Platonists like Plotinus (205-270) and Proclus (410-485) rejected Aristotle's theory of time.⁶²

Having established that time and space are essential prerequisites for all other existence Warner then argues that 'the first thing that offers itself for a subject to the state of existence or non-existence is matter'.⁶³ Once again Warner's definition is strictly neo-Platonic:

The very quiddity and proper essence of matter is corporeity or resistibility (or antitypia or

hardnes) for in that it is continuall or hath the three corporeall dimensions of longitude, latitude and profundity it agrees with space to wch that condition doth properly or at least primarily belong ...⁶⁴

Warner's comment here is particularly important because it shows his recognition of the need to deny the Aristotelian identification of body with three-dimensional extension. Warner insists here that the so-called 'corporeall dimensions' are actually the proper qualities of space rather than body.⁶⁵

This being so, Warner must characterize matter in a different way. Here again he draws upon neo-Platonic traditions. Even Warner's use of the word 'antitypia' betrays that influence since it is a word frequently used by neo-Platonic writers (and in exactly the same sense) but rarely found elsewhere.⁶⁶

Having defined matter, Warner must press on because his system is still incomplete. Time, space and matter could remain:

without the access or production of any other thing & with out any alteration or difference in themselves, both in eternal time and infinite space.⁶⁷

However, such a state of affairs is 'repugnant to the testimony of our senses and present appearances'.⁶⁸ What Warner's system lacks is an active principle to account for the phenomena of motion:

neither time and space at one, nor time and space with matter are sufficient without the position of some fourth thing for the production of all the

species, motions, alterations and affects wch are actually apparent in the universe. Some such fourth thing is therefore to be admitted and the nature and conditions thereof as of a thing fit for such and such offices and the execution of such and such effects is to be examined and considered of.⁶⁹

A little later, while reiterating this point he gives a name to this 'fourth thing':

as none of these [phenomena] that are in motu (as they all are) can possibly be salved by the solitary existence of matter we must of necessity acknowledg a fourth thing as a cause of motion wch may therefore well be termed vis or power by the quality of his office. Whatsoever his substance or quiddity be.⁷⁰

The nature or 'quiddity' of this active principle - once it is revealed - establishes beyond any doubt the neo-Platonic nature of Warner's thinking. Referred to variously as vis radiativa or 'vertue radiative' we are told that this fourth principle is, like space, a three-dimensional incorporeal entity.⁷¹ The clearest indication of its true nature, however, reads as follows:

All bodies have in them an efficient power or vertue wch may be called light whether sensible or insensible.⁷²

It is perfectly clear from this that Warner is drawing upon the neo-Platonic tradition of 'light metaphysics'⁷³ to provide him with his active principle or 'cause of motion'.

The tradition of light metaphysics apparently originated with Plotinus and subsequently became a distinguishing

feature of neo-Platonic thought.⁷⁴ Essentially, the tradition owes its origins to the belief that light provides the closest physical analogue to the nature of the God-head, and to the Creator's means of operating in the world. In theological discussions within this tradition the phenomena of illumination and other aspects of the behaviour of light are often used as metaphors of various theological doctrines.⁷⁵ More important for our purposes, however, is the belief that light performs some universal aetiological function, so that all physical causation is said to take place in a way analogous to the behaviour of light. Indeed, one of the major sources of the light metaphysical tradition is the pseudo-Aristotelian Liber de causis.⁷⁶ As a result of this universal aetiological role light also becomes a fundamental ingredient in various cosmogonical speculations.⁷⁷

The full extent of Walter Warner's neo-Platonism and his place in the tradition of light metaphysics is best brought out by comparing his own system with that of one of the leading neo-Platonist light metaphysicians of the late sixteenth century, Francesco Patrizi (1529-1597). Patrizi is distinguished for being the first philosopher to hold a Chair in Platonic philosophy at any European University.⁷⁸ His works seem to have been well-known in

England and were almost certainly known to Walter Warner.⁷⁹

The similarities between the ideas and even the arguments of Warner and Patrizi are quite remarkable. With the exception of time, Warner's metaphysical principles are exactly equivalent to Patrizi's. Warner's arguments about the nature of space, matter and vis are all prefigured in Patrizi's Nova de universis philosophia.⁸⁰ Patrizi based his cosmology on the four principles of space, matter or fluor as he called it, light and heat. When we realise that heat is in fact just another form of light for Patrizi and that Warner's vis is light the similarity becomes truly striking.

Consider space first of all. Both men subscribe to the Platonic notion of space as the receptacle of all things.⁸¹ Both men argue that space is logically prior to bodies because it can exist without body but body cannot exist without space.⁸² Similarly, Warner's declaration that 'if it [a body] hath being it is containyd in space and if it be contained in space it hath being and yf not in space, no being', can be directly compared to Patrizi's 'if they [bodies] exist they cannot exist nowhere. Hence they exist somewhere and so in some place, and so in Space'.⁸³ Moreover, both philosophers insist upon the homogeneity of space, its total lack of resistance to

penetration, its general passivity, its immoveability and its eternity.⁸⁴ We have seen how Warner regarded the three dimensions of longitude, latitude and profundity as belonging properly to space and yet still slipping into the Aristotelian way of thinking by referring to the 'corporeall dimensions'.⁸⁵ Elsewhere he speaks of incorporeal space being 'corporeally or spherically infinite'.⁸⁶ Patrizi also laboured under the same difficulties of vocabulary. Patrizi tried to confront the difficulties head on by referring to space as a 'corporeal incorporeal' or an 'incorporeal corporeal'.⁸⁷ Cumbersome though Patrizi's designations may be they did at least enable him to proceed beyond the Aristotelian arguments. It may well be that Warner's own talk of space as corporeally infinite and yet completely penetrable is only presented as being unproblematic because Warner has thoroughly absorbed Patrizi's earlier and very detailed arguments.

Similarly, Warner may also have derived his definition of matter from Patrizi. Like Warner, Patrizi characterises matter in terms of its 'antitypia ... which is proper to a body'. It is the resistance to penetration which distinguishes, for Patrizi, between a 'corporeal' and an 'incorporeal corporeal'.⁸⁸ Patrizi's matter principle is referred to as fluor and in its pristine existence it is unformed. The different manifestations of matter in

the natural world and the changes which occur incessantly in nature are brought about by Patrizi's active principle, light. The importance of light in Patrizi's system may be seen from this brief description of his Nova philosophia which he sent to Baccio Valori⁸⁹ in November 1589:

Just as Aristotle discovered the prime mover by way of motion, so in Panaugia /Book I of Nova philosophia/ I find it by way of 'lumen' and 'lux' and then in Pancosmia /Book IV/ by way of a Platonic method I descend to the products of light.⁹⁰

The fact that Patrizi can refer to his natural philosophy, as presented in the Pancosmia, as an account of 'the products of light' shows clearly his position as a light metaphysician. The same position is adopted by Warner when he insists upon an active principle 'for the production of all the species, motions, alterations and affects wch are actually apparent in the universe'. That principle, as we have seen, is 'light whether sensible or insensible'.⁹¹ Even Warner's conception of 'insensible light' is a standard feature of the light metaphysical tradition.⁹²

I believe the similarities between Patrizi's metaphysical principles and Warner's are so close as to suggest a direct influence. Perhaps the truth of this cannot now be established. However, the close similarity between Warner's philosophy and that of the leading late Renaissance light metaphysicist surely makes it undeniable

that Warner himself is best understood as a member of the same tradition.⁹³ Furthermore, in view of the strong influence of Warner upon Thomas Hobbes, which we have already seen, we can expect there to be elements of that tradition visible in Hobbes' Little treatise. Before turning to this we must consider the likely outcome of the other influences upon Hobbes, first pointed out by Pacchi and Gargani, namely Robert Grosseteste and Roger Bacon.⁹⁴

Within the period known to historians as the middle ages, Robert Grasseteste and Roger Bacon were the two foremost exponents of the neo-Platonic tradition of light metaphysics.⁹⁵ Like Plotinus, Proclus, St. Augustine (354-430) and others in this tradition, their imaginations were powerfully effected by the splendour of light. Furthermore, they developed (as Patrizi and Warner were to do later) a natural philosophy which was based on what they took to be the inherent power and efficacy of light. Light was the efficient and the formal cause by which God brought about his creation. The physical world was seen in terms of a series of emanations from God.⁹⁶ The unformed first matter becomes spread out into its three-dimensional disposition by the action of light whose nature it is to spread out spontaneously and instantaneously.

As the light spreads prima materia through the universe it gives it form and produces individual, separate bodies. The crucial role of light in the formation of the physical world is well illustrated by some famous passages from the work of Grosseteste. Although these are well-known it is worth quoting them again here because they so clearly establish the light metaphysical outlook:

The first corporeal form, which some call corporeity, I hold to be light. For light of its own nature diffuses itself in all directions, so that from a point of light a sphere of light of any size may be instantaneously generated, provided an opaque body does not get in the way. Corporeity is what necessarily follows the extension of matter in three dimensions, since each of these, that is corporeity and matter, is a substance simple in itself and lacking all dimensions. But simple form in itself and in dimension lacking matter and dimension, it was impossible for it to become extended in every direction except by multiplying itself and suddenly diffusing itself in every direction and in its diffusion extending matter; since it is not possible for form to do without matter because it is not separable, nor can matter itself be purged of form. And, in fact, it is light I suggest, of which this operation is part of the nature, namely, to multiply itself and instantaneously diffuse itself in every direction.⁹⁷

Light not only provides matter with its three dimensional forms but also provides it with an active principle of motion. In Grosseteste's De motu corporali et luce we read:

But motion is present in every body from an intrinsic principle which is called natural. Therefore an efficient cause simply proportional to the motion is present in all bodies. But nothing is present in common in every body except primitive matter and primitive form and magnitude, which necessarily follows from these two But simply through magnitude a body does not receive motion Not, therefore, simply because of magnitude or

something entailed by magnitude is a body productive of motion. Nor is primitive matter productive of motion, because it is itself passive. It is therefore necessary that motion follow simply from the primitive form as from an efficient cause⁹⁸

The 'primitive form' as we saw in the previous extract is nothing other than light. So, Grosseteste is making essentially the same point as Warner when he wrote 'all bodies have in them an efficient power or vertue wch may be called light'.⁹⁹ Grosseteste is every bit as explicit as Warner and more discursive:

I hold that the first form of a body is the first corporeal mover. But this is light, which as it multiplies itself and expands without the body of matter moving with it, makes its passage instantaneously through the transparent medium and is not motion but a state of change. But, indeed, when light is expanding itself in different directions it is incorporated with matter, if the body of matter extends with it, and it makes a rarefaction or augmentation of matter; for when light is itself charged with the body of matter it produces condensation or rarefaction. So when light generates itself in one direction drawing matter with it, it produces local motion; and when the light within the matter is sent out and what is outside is sent in, it produces qualitative change. From this it is clear that corporeal motion is a multiplicative power of light, and this is a corporeal and natural appetite.¹⁰⁰

Although Grosseteste assumes in this passage that there is 'light within matter' he is clearly not suggesting that all matter is luminous or light-emitting. As we have seen in the case of Warner, there is an implicit assumption that there can be 'insensible light'. Sensible light is only one manifestation of lux which is an emanation of power.¹⁰¹ A similar concept is to be found

in an Arabic philosopher of major influence in the tradition of light metaphysics, Al-Kindi (d. ca. 873). In his influential De radiis stellarum¹⁰² Al-Kindi spoke unspecifically of 'rays' of influence, although it was evident that light provided the major exemplar of such radial power.

'It is perfectly clear [Al-Kindi wrote] that everything in this world, whether it be substance or accident, produces rays in its own manner like a star Everything that has actual existence in the world of the elements emits rays in every direction, which fill the whole world'.¹⁰³

Similarly, Grosseteste's follower, Roger Bacon, chose to use the word species rather than lux to refer to his conception of a general radiation of force or power in the universe. One of Bacon's major works, De multiplicatione specierum¹⁰⁴ is not, therefore, confined to a discussion about light although the particular species of light and colour are those most frequently invoked as examples.

Grosseteste's major work in the tradition of light metaphysics, De luce, Al-Kindi's De radiis stellarum and Roger Bacon's De multiplicatione specierum all appear along with other works in the light metaphysics tradition in Thomas Hobbes' select list of manuscripts in Sir Kenelm Digby's collection.¹⁰⁵ We have every reason to suppose, therefore, that Hobbes knew these works well. But we do not have to leave it as mere supposition. The time has come to return to

Hobbes' Little treatise. We are now fully equipped to see it for what it is: a blend of light metaphysics and the mechanical philosophy.¹⁰⁶

Having established by two conclusions in section 1 of his Little treatise that there are agents 'that hath active power inherent', Hobbes proceeds in section 2 to establish the nature of the effects produced by such agents. It is at this point that he introduces the concept of 'species':

Every Agent that worketh on a distant Patient, toucheth it, eyther by the Medium, or by somewhat issueing from it self, which thing so issueing lett be call'd Species.¹⁰⁷

Since an agent can only effect a patient by contact action of some sort it follows that the agent must either send out these species or stimulate a shock wave of some kind in the intervening medium. While accepting that 'the medium successively wrought on' may transmit an influence, Hobbes prefers to emphasise the efficacy of species. Significantly, all the examples he gives to illustrate the nature of his species and their means of operating rely upon analogies with light. He rejects the transmission of light by a 'successive illumination of the air' because it would result in the transmission of light even round corners which is 'contrary to Experience'.¹⁰⁸ When trying to establish that 'Species proceede infinitely' he shows that the contrary would have to mean that a

heap of sand has a limit of visibility no greater than a single grain of sand.¹⁰⁹ The fact that light passing through a coloured glass projects a coloured image is used to prove that 'Species that come in one and the same straight line from severall objects, are by the sense perceiv'd as one'.¹¹⁰

Hobbes, just like Roger Bacon in De multiplicatione specierum, considers the concept of species to cover all kinds of radiated power - we are told that 'Agents send out their species continually' and 'infinitely',¹¹¹ - but it is clear that light and associated phenomena provide him with the clearest examples. After one of his optical examples he remarks:

The same may be demonstrated in the multiplication of heate Further, from the Experience of Magneticall virtue, and of influence from the Moone on humide bodyes, and generally from the starres on sublunary things, the same may be demonstrated in other species, besides heat, light, and other species visible.¹¹²

Further evidence of the light metaphysical background to Hobbes' thinking in The little treatise is provided by Hobbes' distinction between lux and lumen. This distinction is extremely common in the light metaphysics tradition. Lux is the light of the source, whether it be God, the Sun or a candle flame, while lumen is the brightness derivative from that source.¹¹³ For Hobbes the brightness surrounding a luminous body is derived from

the species surrounding the body and the species themselves are derivative from the source.¹¹⁴

Although Hobbes draws heavily upon the tradition of light metaphysics in The little treatise he has made one fundamental and crucial innovation. Hobbes' species are material substances. In other words they are invisibly small corpuscles of matter continuously emitted from all agents.¹¹⁵ While Grosseteste and Bacon regarded the multiplication of species as a succession of modifications in the surrounding medium, Hobbes insisted that 'species are moved locally'.¹¹⁶ Since Hobbes' prime example of a species is light it follows that light is a body. According to the prevailing view in Hobbes' day, light was propagated instantaneously by a 'successive' modification of the medium.¹¹⁷ But even Hobbes could not countenance the possibility of a body moving infinitely quickly and so had to take pains to deny the instantaneous transmission of light.¹¹⁸

It was the material, corpuscular nature of Hobbes' species which led Frithiof Brandt to regard The little treatise as a thoroughly mechanistic philosophy of nature and as 'Hobbes' most important work on natural philosophy'.¹¹⁹ However, because Brandt was unaware of the sources from which Hobbes drew his major conceptions, he failed to

realise the equally important light metaphysical cast of The little treatise. Without the knowledge of this background it is impossible to understand Hobbes' concept of agents with inherent power to move, and it is no wonder that Brandt found it obscure.¹²⁰ The simple truth is that Hobbes was drawing on an age-old tradition in which light was regarded as a self-active, self-motive entity whose major characteristic was its autodiffusive ability to spread itself out in all directions from a point source. The fact that Hobbes considers light and all other species emitted continually and infinitely from bodies to be bodies themselves¹²¹ forces us to conclude that Hobbes believed that some matter, at least, was inherently active.

Hobbes does not go so far as Al-Kindi and insist that everything emits rays or species in every direction.¹²² He allows some physical phenomena to be explained in the strictly mechanistic sense - by transference of motions in contact actions. Nevertheless, it should not be overlooked that some phenomena are explained by recourse to concepts of innate activity:

Whatsoever moveth another, moveth it either by active power inherent in it self, or by motion received from another.¹²³

Although Hobbes tried to explain many everyday phenomena

in mechanistic terms, he evidently felt no compulsion to explain his active agents, such as the sun, in mechanistic terms, the way Descartes would do.¹²⁴ Hobbes merely established their inherent active power by his rational Euclidean procedure from principles to conclusions and, occasionally, by reference to 'experience'.¹²⁵ Furthermore, there is a strong suggestion in Hobbes' Little treatise that he accepted, as a result of experience, the 'occult' concepts of sympathy and antipathy. It is worth studying this passage in detail. Conclusion 9 of section 2 begins:

There is betweene Species Conveniency and Disconveniency, by which the Agents whence they issue, attrude and repell one the other.

This is manifest by Experience in things that attract or repell one the other by Sympathy and Antipathy. For seeing they touch not one another, and motion of the Attraction or Repulsion is not wrought by alteration of the Medium (by the 2, Concl. Sect. 2)¹²⁶ it must be by Species; and seeing all Agents and Patients do not so move one the other, it follows that those which doe so worke, must worke by somewhat proper to their Species, which is what we call Conveniency or Disconveniency and the Greekes, Sympathy and Antipathy.¹²⁷

Now, it may be supposed that this is simply a typical attempt to explain phenomena normally referred to sympathy and antipathy in mechanistic terms. After all, Hobbes is trying to explain attraction and repulsion in terms of the interaction of material particles (the species). However, I do not believe such an assumption is entirely justified in this case. Let us consider Hobbes' example:

Hence may be collected the manner how the Loadstone attracts Steale. For the Species of the Loadstone meeting with the Species of the Steale in the medium, do so fortify their motion by conveniency with them, that they issue out of the steale, with more speede and abundance than otherwise they would; and the body of that steale admitting but a determinate afflux, is drawn to follow after the Species, and so is moved to the Loadstone.¹²⁸

Hobbes is suggesting here that steel is sucked towards a magnet because its species, usually emitted with a 'determinate afflux' are drawn out more quickly and in greater numbers than usual and so resulting in the motion of the steel itself. But how are the species drawn out? There is no suggestion that the species of the magnet enter into the steel and drive them out that way. We are specifically told that they meet 'in the medium'. It seems that Hobbes is explaining the attraction of steel towards a magnet in terms of the attraction between the species of steel and the species of a magnet. The statement that the species of steel 'fortify their motion by conveniency' with the species of the magnet cannot possibly be reduced to a mechanistic explanation, especially when we realise that the species of steel and the species of the magnet must be travelling in opposite directions when they meet 'in the medium'.¹²⁹

Whether my interpretation of this passage is accepted or not - admittedly Hobbes is so elliptical that his true meaning may remain inscrutable - the view of The little treatise as purely and simply a work of mechanical philosophy can no longer be upheld. Hobbes' early

natural philosophy depends very largely upon the assumption that some matter in the universe, if not all,¹³⁰ has an innate tendency to move and is, therefore, self-active. Assuredly it is mechanistic in so far as it tries to explain phenomena in terms of matter and motion but it is very different from the Cartesian notion of the mechanical philosophy, in which all matter is passive and motion is initiated and preserved from outside by God.¹³¹

Subsequent chapters in this thesis will show that the approach adopted by Hobbes in The little treatise was by no means unusual. The Cartesian belief that a fixed amount of motion was impressed upon passive matter at the Creation and subsequently distributed, transferred and preserved by means of collisions in accordance with the laws of motion was never wholeheartedly accepted by any of the leading English 'mechanical philosophers'. On the contrary, the metaphysical problem of motion and its origin always led these thinkers to subscribe to some form of unexplained active principle. Furthermore, I hope to be able to show that in nearly every case the tradition of light metaphysics played a part in seventeenth-century English attempts to account for the unceasing motions of matter.

A.C.Crombie in his indispensable study of Robert Grosseteste

and the origins of experimental science, 1100-1700¹³² has already shown the importance of the light metaphysical tradition in the establishment of modern science. Dr Crombie indicated the ways in which this tradition led not only to experimentalism but also to the seventeenth-century attempts to analyse nature in mathematical terms.¹³³ I hope that this present study will complement Crombie's earlier work by showing the importance of light metaphysics not only to the methodology of modern science but also to its metaphysical foundations.

I hope I have shown that Hobbes' earliest attempts to develop a natural philosophy in which all phenomena were to be explained in terms of matter in motion was not strictly mechanical. His system relies to a large extent on some form of inherently active matter. Although this active principle is fully in keeping with Hobbes' materialism (since it is material) it owes its conception to the age-old notion of light as a self-active principle whose major characteristic is to spread itself out spontaneously in all directions. The autodiffusion of light had been seen as a means of producing change in the material world. Light could produce qualitative change in matter or it could put matter in motion. As St. Augustine put it, light 'is ultimately the origin and principle of natural motion'.¹³⁴

The picture of Hobbes presented here is far from familiar and it would be unforgiveable to leave the story here. Almost immediately,¹³⁵ Hobbes changed his mind about some of his fundamental assumptions in The little treatise and he moved progressively further from his light metaphysical beginnings. By the time Hobbes came to publish his De corpore (1655) he had developed a mechanical philosophy in the strict sense. Matter was inert and motions were merely preserved and transferred by impact. The motions in nature all originated from an initial push by the first cause, God.¹³⁶ Hobbes could now dismiss his own earlier efforts along with all other natural philosophies:

as for those that say anything may be moved or produced by itself, by species, by its own power, by substantial forms, by incorporeal substances, by instinct, by anti-peristasis, by antipathy, sympathy, occult quality, and other empty words of schoolmen, their saying so is to no purpose.¹³⁷

However, Hobbes did not achieve this strictly mechanical position until 1655, by which time he was no longer a pioneer. We will investigate the reasons for this delay and the problems confronting Hobbes' strictly mechanical account in Chapter 4. While Hobbes procrastinated English philosophy did not wait for him. In 1644, the year that Descartes published his Principia philosophiae,¹³⁸ the first fully-developed system of mechanical philosophy to be written by an Englishman was

also published. What is more, this work, Sir Kenelm Digby's Two treatises, was written in English.¹³⁹ The full significance of this work has never been appreciated. It is my contention that its importance lies, not so much in the technical details of its science or philosophy, but rather in the ideological and religious intentions underlying its composition. The time has come to introduce the second major theme of this thesis.

CHAPTER 3

THE CATHOLIC ORIGINS OF THE MECHANICAL PHILOSOPHY:

SIR KENELM DIGBY, THOMAS WHITE AND 'ARISTOTELIAN ATOMISM'

The fact that Sir Kenelm Digby's Treatise on body, the first of his Two treatises,¹ was the earliest fully developed system of mechanical philosophy to be written by an English thinker should have ensured it a prominent position in the history of English science. However, it has tended to be dismissed as merely an interesting oddity which throws no light whatsoever on the historical development of the new science.² The reasons for this are essentially two-fold. Firstly, Sir Kenelm Digby (1603-1665) was a staunch, indeed a notorious, Roman Catholic. Digby's work has been dismissed, therefore, as irrelevant to the development of science at that time because it could not be fitted into the historiographical thesis that the new science was developed by Puritans. Even those historians who have sought to refute the Puritanism-and-science thesis have not made a close study of Digby's philosophy but have preferred to negate and deny the various details propounded by the subscribers to the so-called 'Merton thesis'.³ The second reason for Digby's ignominy in the eyes of historians of science is his undoubted enthusiasm for and adherence to the principles of Aristotle. Here again, Digby cannot be fitted into the prevailing historiographical assumptions. The 'Scientific Revolution' is characterized as the overthrow

of Aristotelianism. No advocate of Aristotle, the argument goes, could possibly have contributed to that revolution.⁴

In this chapter I hope to show that, despite the prevailing historiographical positions, a full consideration of Digby's natural philosophy and its background is essential for a complete understanding of the development of natural philosophy in seventeenth-century England. Digby was not a solitary figure, writing natural philosophy during the years of Puritan ascendancy because 'for those excluded from civil office or political participation, the sciences were an unexceptionable form of recreation'.⁵ On the contrary, Digby developed his natural philosophy, like the Puritans, with conscious reference to his religious views in order to promote a particular theological standpoint.⁶ Digby embarked upon his studies in natural philosophy side by side with a Catholic priest who was the leader of a heterodox faction of English Catholics. Sir Kenelm Digby and his mentor, Thomas White (1593-1676), were the leading members of a counter-reforming group of Catholics known as the Blackloists (after one of White's pseudonyms, Blacklo).⁷ These two men developed a mechanical system of philosophy, I contend, in order to promote their own counter-reforming religious views. They believed that they could re-establish the true faith with the aid of reason and philosophy. As we explore this previously overlooked aspect of seventeenth-century

natural philosophy we will be providing much more than another negative critique of the Merton thesis. By uncovering the ideological intentions of the Blackloists and the role played by natural philosophy in their endeavours we will enrich and expand the prevailing historiography beyond the bounds of the Puritanism-and-science thesis.⁸

1. The origins of the Blackloist religio-political programme.

Although he was brought up as a Roman Catholic, Digby abandoned his mother church in 1630 and became an Anglican. It may be that he became disenchanted with the Catholic church at this time because he recognised that 'Rome fetters reason', but for the most part his conversion seems to have been an understandable case of opportunism, in order to avoid the disadvantages of being Catholic at a time when Catholicism was anathema to most Englishmen.⁹ However, by 1635 he had returned to the church of his birth, and shortly after this (1638) he embarked upon his career as a philosophical writer. Undoubtedly Digby reached this turning point and was given new direction by the aid and influence of the now little-remembered Catholic priest, Thomas White. Very quickly after their first meeting White's influence upon Digby became more and more profound. Digby seldom failed to recommend the philosophy of this priest who, thereby, was initiated into Mersenne's circle and attracted the interest of Digby's friends, Descartes and Hobbes. Digby repeatedly referred to White as his master, mentor, and teacher. He once wrote to White saying that his whole philosophy had been shaped by the priest, even going so far as to

say:

I should not lie if I said that your redeeming me out of vulgar ignorance hath been in some regard a misfortune to me, as the cure of madness was to the poor wretch who then saw his misery.¹⁰

The congruence between the ideas of these two men can be seen from even a cursory comparison of their published works, and yet the full significance of this intellectual partnership has yet to be fully assessed.¹¹

Unfortunately it is not possible to give an exact date for their meeting, but the circumstances which brought them together are fairly evident. It is reasonable to assume that during the few years which Digby spent as an uneasy Anglican he would have been interested in ecumenical movements. During this period he was a close friend of Archbishop Laud whose 'high-flying' Anglicanism was often thought to be dangerously close to Catholicism.¹²

Quite quickly after Digby's conversion to Anglicanism there was a softening in attitude towards Catholicism among many Englishmen, and there were even a number of converts to the Church of Rome. Perhaps the most surprising of these was the temporary conversion of William Chillingworth, a thinker more usually known for his vociferous opposition to Catholicism.¹³ It began to seem to the Papal authorities that some sort of reconciliation between Rome and Canterbury was possible and in 1634 Pope Urban VIII sent Gregorio Panzani over to England to negotiate along ecumenical lines.¹⁴

In 1633 a former colleague of Thomas White at the English College in Douai, Christopher Davenport, published Deus, natura, Gratia¹⁵ which argued that no fundamental dogmas separated Anglicans and Catholics, White indicated his own ecumenism by writing a commendatory preface to the work. During Panzani's visit, White played a large role in his attempts to reconcile rival factions among English Catholic clergy. By 1636 when Panzani left England, White had emerged as a powerful figure in the secular clergy and had even been nominated as a possible candidate for the Bishopric of Chalcedon - the Catholic Bishopric so-called in order not to 'prejudice any right his majesty hath to the nomination of English bishops'.¹⁶ It seems quite likely that Digby became acquainted with White during these hopeful times for Catholics, and that White was one of the Catholic friends who, we are told by Laud, guided Digby back to his mother Church in 1635.¹⁷ Certainly, by 1637 both men were well acquainted.¹⁸

The ecumenical intentions of the Blackloists had their beginnings during these times, but the hoped for reconciliation between Rome and England did not materialise. Digby and White, however, despaired of nothing. From this time onwards they dedicated all their efforts to gaining toleration for English Catholics. Thomas White's most recent biographer¹⁹ has argued forcefully that, as far as White was concerned, all his writings, in whatever field of human knowledge, were part of a unified whole,

a comprehensive system of religion, politics and philosophy. When one of White's most trenchant critics objected that it was not possible to know where his philosophy ended and where his theology began, White merely replied: 'I see not how you could give a scholar a greater praise'.²⁰ On another occasion White declared that all his endeavours were directed towards showing the conformity of faith with 'inferior sciences'.²¹ It is my contention that the one guiding principle which directed all of White's unified efforts was his belief in the importance of ecumenism.

White and his faithful follower and accomplice, Digby (along with other followers), tried to accomplish this (as we shall see) by direct political means: Negotiating with members of the English Government or with Papal authorities in Rome. But what is more significant from our point of view is that they hoped to gain toleration for Catholics by making a deliberate effort to develop a reformed Catholic theology which was close to, or amenable to, English Protestant thought. Their writings, therefore, were all carefully composed with a view to removing those doctrinal differences between Catholics and English Protestants which stood in the way of reconciliation. In order to see this we must briefly examine the way their works developed from the late thirties to the early sixties.

In their earliest published works Digby and White tried

to defend the Catholic emphasis on tradition as an authority equal to the scriptures. For Catholics, the oral traditions of the early Church seemed to be every bit as reliable as the written testaments because they, so Digby and White claimed, could all be traced back to the direct teachings of Christ. While study of the scriptures alone could lead a man to the truths of religion, more often than not the difficulties of interpretation will lead to error and controversy. The proliferation of different sects within Protestantism testify to this. It is necessary, therefore, to be guided by the use of reason and by the traditional interpretations given to those controversial parts of scripture by the early members of the Church. These early fathers, of course, had every advantage over the moderns in being able to determine Christ's original meanings. Those to whom Jesus preached, they argued, ought to be believed as firmly as Jesus himself. The Roman Catholic Church was held to be unique in having an unbroken line of masters and disciples which could be traced back to Christ and his original chosen disciples. This was sufficient to guarantee that no false doctrines or errors could have crept in: only what Christ himself taught has been handed down. As White put it: 'If we look into the immediate progresse and joints of the descent we cannot find where it can misse'.²² Digby concluded that it was safe to allow oneself to be:

guided by the unanimous consent of the wisest,

the learnedest, and the piousest Men of the whole world, that have bene instructed in what they believe by men of the like quality living in the age before them, and soe from age to age untill the Apostles and Christ, - and that in this manner have derived from that fountayne, both a perfect and a full knowledge of all.²³

Now, White first developed these ideas in the context of a polemic with the Anglican apologist, Lucius Cary, Viscount Falkland (1610-1643). However, White's An Answer to the Lord Faulklands discourse of infallibility was not the last word on the matter. Falkland himself was quick to reply and his close associate, William Chillingworth (1602-1644) also entered the lists by composing a refutation of White's ideas which was published posthumously.²⁴ We also know that Chillingworth and White debated this topic face to face in Digby's lodgings sometime between 1635 and 1637.²⁵ The arguments of Falkland and Chillingworth were essentially the same. They sought to show that the doctrinal development of the Roman Church was by no means as smooth and indeflectable as White and Digby wanted their readers to believe. They were able to find a number of doctrines which separated Protestant and Catholic and which they could show had equally divided Catholic from Catholic in the past. The major doctrinal issues were the immaculate conception of the Blessed Virgin, infants receiving the Eucharist, transubstantiation, Papal infallibility and eschatological beliefs.²⁶ From this moment on the theology of Digby and White underwent an astonishing transformation. They recognised that the arguments of Falkland and Chillingworth

were sufficient to undermine completely their own arguments about the infallibility of tradition and the historical coherence of orthodox Catholic theology. From then on White and his followers became convinced of a genuine need to reform the Catholic Church from within. White and the Blackloists now began to reject certain Catholic dogmas in the hope of making their own reformed Catholicism not only more amenable to English Protestants, but also more conformable to the true faith.

When White wrote his own mechanical system of philosophy, an expansion of Digby's Two treatises, he showed no hesitation in denying that an accident could exist out of its own subject. As White himself pointed out, he thereby denied Catholic teaching upon transubstantiation: nevertheless he was adamant:

'Tis answered there's neither Authority nor
Demonstration in Theologie, which convinces that
an Accident may be preserv'd out of a Subject ...²⁷

Similarly, he indicated that he held no brief for Catholic Mariology.²⁸ However, by far the most important aspect of the new theology of White and Digby was their rejection of the concept of purgatory and their development of a new Catholic eschatology.

Much recent research has shown the prevalence and importance of apocalyptical beliefs and related eschatological concepts

in seventeenth-century England.²⁹ The work of White and Digby, completely overlooked in all of this research, is highly significant in this respect and adds greatly to our understanding of this recent historiographical development. In view of the apocalyptic excitement which we now know was stirred up in those times, it is hardly surprising that White and Digby recognised its importance in English religious thought. Furthermore, Digby's friend Thomas Hobbes, as is well known, was developing his own eschatology which emphasised the resurrection of the body and the Last Judgement.³⁰ And then, in those works of Falkland and Chillingworth directed against White, millenarianism appeared as one of the major examples of a piece of early Catholic tradition now rejected as heresy.

Chillingworth rightly insisted that the 'doctrine of the millenaries' was 'by the present Roman Church held false and heretical'.³¹ However, bearing White's criteria in mind it ought to be part of the true faith because it was 'believed and taught by the Eminent Fathers of the Age next after the Apostles, and by none of that age opposed or condemned'. Irenaeus, for example, was said to have derived it 'from Priests which saw John, the Disciple of the Lord'.³² Similarly, Justin Martyr is quoted as saying that those who denied the millennium also denied the Resurrection.³³ Furthermore, the doctrine

of millenarianism is to be found in the Revelations to St John and were accepted parts of Christian belief within thirty years of his death, 'when in all probability there were many alive, that had heard him expound his own words and teach this doctrine'.³⁴ It remained part of the orthodoxy, according to Chillingworth, for two hundred and fifty years until contradicted by Dionysius Alexandrinus.³⁵

Although Falkland and Chillingworth invoke millenarians in this way it should not be assumed that they were thoroughgoing millenarians themselves. The evidence tends to suggest that they were simply using these arguments to demonstrate the untenability of the Catholic claim to a theology based on the earliest traditions of the Church. In fact the recent proliferation of studies on millenarianism has rather tended to obscure the fact that it was regarded by most English thinkers as an unorthodox view, which could lead to heresy in religion and political upheaval in everyday life.³⁶ This is not to say that orthodox Anglicans denied the general resurrection and the Last Judgement, but for the most part they concentrated more on the very clear scriptural statements that the blessed would enter heaven and the damned would be punished immediately after death. This emphasis straight away raises questions about the importance of the Last Judgement - most obviously: why should it be necessary at all? Anglicans for the most part followed

Calvin's teaching in the Institutes of the Christian religion:

... as the Scripture uniformly commands us to look forward with eager expectation to the coming of Christ, and defers the crown of glory which awaits us till that period, let us be content within these limits which God prescribes to us - that the souls of pious men, after finishing their laborious warfare, depart into a state of blessed rest, where they wait with joy and pleasure for the fruition of the promised glory; and so, that all things remain in suspense till Christ appears as the Redeemer. And there is no doubt that the condition of the reprobate is the same as Jude assigns to the devils, who are confined and bound in chains till they are brought forth to the punishment to which they are doomed.³⁷

The Last Judgement, therefore, is still anticipated but, in the mean time, the departed souls are kept at some sort of half-way stage. It is essential to think in such terms in order to account for Jesus' promise to the blessed thief: 'Today shalt thou be with me in paradise',³⁸ and for the fact that Dives, after his death, could see Lazarus comforted in 'Abraham's bosom'.³⁹ Jeremy Taylor, writing in 1649, explained the quandary by relying on a distinction made by St Paul between paradise and the highest heaven:

for paradise is distinguished from the heaven of the Blessed, being itself a receptacle of holy souls, made illustrious with visitation of Angels and happy by being a repository for such spirits, who at the first day of Judgement shall go forth into eternal glory.⁴⁰

From this point of view, however, it seems that the Last Judgement has been reduced to a mere formality: those in Abraham's bosom know their blessedness will be ratified, while those 'bound in chains' must know there will be no reprieve.⁴¹ The only way that Orthodox theologians could

make the Last Judgement relevant was to argue that complete justice could not be meted out to the whole person, body and soul, without the resurrection of the body. In life the bodies of the innocents suffered as much as their souls and bodies too deserved their rewards, and conversely it was often bodily pleasures which led the wicked astray and so it is fitting that their bodies should be punished.⁴²

In spite of these efforts it should still be recognised that, in general, the Day of Judgement was played down by representatives of orthodoxy and more emphasis was given to the immediacy of punishment or reward after death. This was partly in order to avoid encouraging the political and social upheavals that seemed inherent in the millenarian views, but orthodox thinkers were also determined to reject the heresy of mortalism which was becoming, from their point of view, alarmingly prevalent. Mortalism, the belief that the soul dies with the body or, in a less extreme version, remains sleeping in total oblivion until the resurrection (when it is resuscitated along with the body), was feared to have social implications as bad as those of millenarianism. If the soul died with the body then the normal religious constraints towards good morals counted for nothing, and immorality of the worst kinds would ensue. Implicit in these fears

is the assumption that reward or punishment deferred indefinitely to the time of the Last Judgement would simply be ignored by most people.⁴³

Be that as it may, the more radical protestant thinkers were not satisfied with the comparatively unimportant Last Judgement of orthodoxy. For them, the bodily resurrection and the Last Judgement were the major aspects of their belief; the culmination of the history of the world.⁴⁴ The state of souls between death and the eventual Judgement Day, therefore, required more careful consideration than it was granted by conservative theologians. It was clearly for this very reason that mortalism became so prevalent.

It is only in the light of all this that we can see the ideological purpose behind the philosophical works of Digby and White. In order to reunite all Christians: Puritan, Anglican and Catholic, in a reformed Ecumenical Church, Digby and White would have to rediscover the true faith. Furthermore, they had to be able to demonstrate that it really was the one true faith in order to persuade all Christians to join them. In general terms they sought to do this by developing a unified philosophical theology based on what they took to be the three major sources for incontrovertible knowledge: scripture, tradition and reason. Throughout their work Digby and White return again and again to these three sources as the only infallible guides to the doctrines of the true faith, and it is this which accounts for the striking

coherence of all White's works which has already been noted.⁴⁵ More specifically, what the Blackloists required was a reformed theology which would include the early traditional belief in the general resurrection and the Last Judgement, but would also avoid the mortalist heresy and prove the immortality of the human soul.

2. The mechanical philosophy in the service of eschatology.

The first major step towards this counter-reforming theology was made in Digby's Two treatises. Although it is the Treatise on body which has attracted most attention from historians of science, for Digby the really important part of the work was its development of a comprehensive physiology of the human soul, in the second treatise. As he wrote in the 'Dedicatory epistle', he intended to study corporeal agents only in so far as 'the knowledge of them serveth to the knowledge of the soul'.⁴⁶ That the Two treatises were actually written with this religious purpose in mind is also clear from what Digby wrote in 1642 in his Observations upon Religio medici.⁴⁷ In this short work Digby insists that the immortality of the soul can be demonstrated by philosophy 'as well as faith delivereth it':

I take the immortality of the Soule (under his [Browne's] favour) to bee of that nature that to them onely that are not versed in the wayes of proving it by reason, it is article of faith; to others it is an evident conclusion of demonstrative Science.⁴⁸

He then gives advanced notice that he has demonstrated the immortality of the soul by rational means in a long

philosophical work. It would seem from this that the Two treatises were actually written sometime before the end of 1642. Digby also makes it abundantly clear that his philosophy can be used to refute mortalism:

I shall observe how if hee had traced the nature of the soule from its first principles, hee could not have suspected it should sleepe in the grave till the Resurrection of the body.⁴⁹

In order to trace the nature of the soul, however, Digby felt it 'an unavoydable necessity' to deal in an exhaustive way with the nature of bodies. Furthermore, he recognises the need to explain all the properties of bodies in mechanical terms. The current doctrines of the schools make no real distinction between material and spiritual things whose operations are alike attributed to 'certain powers or qualities' and so, as Digby complains:

What hope could I have, out of the actions of the soule to convince the nature of it to be incorporeall if I could give no other account of bodies operations, then that they were performed by qualities occult, specificall or incomprehensible?⁵⁰

If, on the other hand, he could banish occult qualities and powers from the realm of physics he would be at liberty to explain spiritual phenomena in terms of occult qualities. An exhaustive account of the phenomena of bodies which relied only on the principles of the mechanical philosophy would enable Digby to show that the operations of the soul:

are such as cannot proceed from those principles, which being adequate and common to all bodies we may rest assured, that what cannot issue from them, cannot have a body for its source.⁵¹

The essence of Digby's thesis is to show that the soul is incorporeal and to go on from there to demonstrate its immortality. Mortality, involving change, decay, dissolution and so forth, can only apply to material entities since all change can ultimately be explained in terms of the rearrangement in space of the constituent parts of bodies. A separated or 'unbodyed' soul, therefore, must be completely incapable of change. The very last chapter of the Two treatises treats 'Of the perseverance of the soul in the state she findeth her selfe in, at her first separation from her body'.⁵² Here, Digby reaches the conclusion that 'no change at all can happen to an abstracted soul'.⁵³ Once again, there are intimations of these ideas presented in his Observations upon Religio medici. For example, he tells us that 'in the state of eternity there is no succession, no change, no variety. Soules or Angells in that condition, doe not so much as change a thought'.⁵⁴ He also takes Browne to task for implying a contradiction 'in his consideration of the activity of glorified eyes (which shall be in a state of rest; whereas motion is required to seeing)'.⁵⁵

Implicit in Digby's conclusion to the Two treatises is a denial of the Catholic concept of purgatory. If the soul is unchanging after death then it is ludicrous to suppose that souls can be purged of their sins before

the resurrection on the Day of Judgement.⁵⁶ Digby

makes it rather more explicit in his shorter Observations:

to be in such a condition as maketh us understand damned soules miserable; is a necessary effect of the temper it is in, when it goeth out of the Body, and must necessarily (out of its owne nature) remain in, invariably for all eternity.⁵⁷

It is quite evident that Digby's Treatise on body, the earliest fully worked-out system of mechanical philosophy in English was written to provide a philosophical basis on which to erect a new eschatology.

The details of this new eschatology were set out clearly and fully for the first time in Thomas White's De medio animarum statu, which was published in 1650.⁵⁸ This work marks the culmination of White's attempts to arrive at a reformed Catholicism with no fundamental doctrinal differences from English Protestantism. With this new theology he believed he could bring together the more radical Protestant sects which emphasised the apocalyptic and eschatological features of Christianity and the more conservative Anglicans who tended to deny or play down the apocalyptic aspects. By paying sufficient attention to the 'middle state' of souls, he believed he could avoid the heresy of mortalism while also placing great emphasis on the importance of the resurrection and Last Judgement. As he himself insisted: 'whether we cast our eyes on the old or new Testament, we shall find our faith founded and rooted in the resurrection'.⁵⁹

From the outset of White's Middle state of souls it is

clear that the author has thoroughly absorbed the criticisms of Falkland and Chillingworth. However, this does not mean that he must rescind his views on the infallibility of tradition. On the contrary, he reaffirms it by following the paths indicated by the two Protestants. He categorically repudiates the concept of purgatory as something 'new in the Church' and so not part of true tradition.⁶⁰ Furthermore, from the stand-point of his own natural philosophy he is able to argue that the very idea of purgation of sins after death and prior to a bodily resurrection is completely untenable.

Following Digby, he argues that only corporeal entities can suffer from external corporeal agents such as fire or instruments of torture. It is 'a fiction vain and altogether impossible', therefore, to suppose that a spiritual, 'indivisible subject' like the human soul could be affected by such external agents.⁶¹ But, if it is true that purgatory cannot purge the soul, it must also be true that the soul cannot suffer in hell-fire. It would seem that White's theology is leading him towards mortalism.⁶² White manages to avoid this by introducing a concept of internal gladness or, when appropriate, suffering. In other words he introduces a strictly psychological interpretation of Abraham's bosom, and the torments of the soul in the interval between death and the resurrection. So, just as 'the Embrio or seminal concreation delineats the future man', similarly

the whole course of a man's life will determine the state of his soul at the moment of his death. As White himself puts it: 'to have had, in the course of his whole life, these and these thoughts and affections, designs and points out, by the impressions left, the future condition of his soul'.⁶³ However, as soon as the soul becomes separated from the body it is no longer capable of or susceptible to change - since change is a physical phenomenon which it is nonsensical to apply to spiritual entities.⁶⁴ Therefore, the disembodied soul must remain in the state it was in at the very moment of death: 'the Entity so made continueth such', White says, 'till it be, as it were, new moulded, which is the worke of the Resurrection'.⁶⁵

The soul neither dies nor sleeps, then, but remains fully self-conscious, indefinitely, in a state of self-inflicted guilty torments or tranquil joy, until the resurrection when it is once again conjoined to the body. The whole person, body and soul, can then suffer hell-fire, or be 'admitted locally to Heaven'.⁶⁶ White sums it up like this:

Being therefore by the operation of death, as it were new moulded and minted into a purely spiritual substance, he carries inseparably with him the matter of his torment in the like manner as he also doth who takes leave of the body with his affections only venially disordered. We have no occasion here to employ infernal Architects to invent strange racks and dungeons, since the innate and intimately inhering strife and fury of the affections bent against reason, perform alone that execution;

which is therefore proportional to the sins, because springing and resulting from them, nor ever otherwise possibly capable to cease and determine, unless the soul by a new conjunction with the body, became again susceptible of contrary impressions.⁶⁷

Clearly, White's carefully-thought-out natural philosophy, leading him to his new psychology of the disembodied soul, enabled him to develop a theology which he believed could resolve the exegetical problems of eschatology which divided English Protestants. Furthermore, if Catholics would accept, as he had, the arguments of Falkland, Chillingworth and other Protestants, that purgatory was not part of the true tradition of the Church, then White's theology could be accepted by all as the true faith.⁶⁸

The fact that the Blackloists' natural philosophy was intended to provide a foundation for the establishment of their new theology did not go unrecognized by their contemporaries. The link between their 'new system of philosophy' and 'Divinity' was made explicit by one of their most eloquent critics when he drew up an analysis of the historical development of their work:

Now as the order in which this new fabrick of Purgatory, and indeed the whole new system of philosophy and Divinity was made publick; it was (as I take it) this: after the Book of the immortality of the soul, fathered on Sir Kenelme Digby; Master White appeared himself on the stage, under the name of Thomas the Englishman ... where,

in a moderate volume entituled Peripatetick Institutions He discovered the great mine of this Phylosophy; here the suttleties of Logick, the secrets of nature, the hidden properties of bodies, both heaven and earthe are layed open⁶⁹

Similarly, another observer declared that Digby:

was easily wrought upon to help to bolster up and spread the Atomical philosophy, which Blacklo persuaded him would shortly prevail in the Christian world ... which Honour they said he should have of founding this new doctrine, & divinity it self, which was to be new modeled also according to these unheard of principles⁷⁰

It should also be noticed that White's new eschatology carried with it some important corollaries which could only have helped his ecumenical designs. Keith Thomas has pointed out that the belief in ghosts - souls revisiting their haunts from purgatory - was seen as a Catholic superstition which tended to be denied by Protestants.⁷¹

For this very reason, White was concerned to deny the reality of ghostly appearances.⁷² More importantly, White's denial of purgatory undermined the validity of indulgences. The idea of buying one's way out of purgatory, to which the concept of indulgences so often amounted, was anathema to Protestants. Besides, the abuses of indulgences were still remembered as one of the major incentives to the initial Lutheran reformation.⁷³

3. The Blackloists and political developments.

Thomas White and his fellow traveller, Kenelm Digby, it

should now be said, were not such ivory-tower intellectuals that they believed their new philosophical theology would be sufficient to achieve the ecumenical ends for which they yearned. Both men, and their devoted group of followers who were mostly, like White, secular priests, were actively engaged in various political machinations all bent upon the same objective. The full details of these political manoeuvres are extremely complex and have yet to be fully charted, but the broad outlines are perfectly clear.⁷⁴ In 1639 Digby had been prevailed upon by Queen Henrietta Maria to ask English Catholics for funds which would enable King Charles to put down the Scottish rebellion.⁷⁵ This marked the beginnings of a close relationship between Digby and the Queen. In 1644 when Henrietta Maria arrived in Paris she made Digby Lord Chancellor of the Court-in-exile, and commissioned him to go to Rome to entreat for Catholic funds. This errand was potentially crucial not only to the plight of the King, now embroiled in the first Civil War, but also to the future of English Catholicism. It is not surprising, therefore, that Thomas White chose to accompany his close friend on this mission to Rome.⁷⁶

Needless to say, Digby failed in his endeavour. The Pope's conditions were ludicrously impractical, including, for example, the conversion of Charles.⁷⁷ A second and longer sojourn at Rome from 1646 to early in 1648

also produced no results. Digby was profoundly disappointed at his failure to help his King and Queen and there is good evidence to suggest that he was thoroughly disgusted with the Pope, Innocent X.⁷⁸ It seems that White too, shared this low opinion of the Papacy and as a result decided to emphasise what previously had been only implicit in his intentions. The main problem confronting English Catholics, and preventing their toleration by English Protestants, was, at its simplest, the belief that no-one could be the servant of two masters: King and Pope. White and his followers, therefore, began to promote a schism between English Catholics and the Papacy. By this time the Blackloists constituted a powerful faction in the Chapter of secular clergy.

Many of the details of their schismatical plotting have been preserved in an account evocatively entitled: Blacklo's cabal.⁷⁹ In September 1647 the Blackloists drew up a list of 'Instructions' in which they detailed the concessions which Catholics should make in order to gain toleration of worship. These included taking an oath of loyalty to the English Government, denying fealty to the Pope, the establishment of six or eight Bishops who were completely autonomous and concerned exclusively with spiritual matters, and finally, the Blackloists recommended the expulsion of the Jesuits,

who were seen as the biggest obstacle to ecumenism.⁸⁰

By this time, of course, the King's cause was in ruins and the Government which had to be persuaded to grant freedom of worship was that of the rebels. It is an indication of the single-mindedness of the Blackloists that in 1649 shortly after the execution of the King, Digby returned briefly to England and once again negotiated for toleration for his fellow communicants. This time, he was dealing, in secret, with Oliver Cromwell, but like his other efforts it came to nothing. As well as a denial of the temporal power of the Pope, Cromwell wanted English Catholics to provide an army of ten thousand men for the service of the Commonwealth. Neither Digby nor any other Catholic could guarantee that.⁸¹ Even so, Digby did not despair and, as is well known, when Cromwell became Lord Protector in 1653, he returned to England and recommenced his efforts. And so, surprising though it may seem, this man who was once so ardent in his support of the King, now became something of a favourite in the eyes of the Lord Protector.⁸²

Meanwhile, the philosophical work of Digby and White was beginning to win the approval of leading Protestant thinkers. When John Webster recommended the reform of the university curriculum in his Academiæ examen of 1653 he took for granted the importance of Digby

and White:

What shall I say of the Atomical learning revived by that noble and indefatigable person Renatus des Cartes, and since illustrated and improved by Magnenus Regius, White, Digby, Phocyllides, Holwarda and divers others.⁸³

It would be wrong to assume that Webster was so radical as to be unrepresentative. It has been pointed out that the works of Digby and White frequently appeared alongside those of Descartes, Gassendi and Mersenne on the shelves of Oxford College libraries just after the Civil Wars.⁸⁴ And Thomas Barlow of Queen's College included their works in his recommendations for A library for younger schollers.⁸⁵ When Webster's book was answered by the more conservative Seth Ward and John Wilkins, the mechanical philosophy of our two Catholics was spared from the vilification heaped upon that of Thomas Hobbes.⁸⁶ Indeed, Ward accused Hobbes of plagiarising from 'Des Cartes, Gassendi, S.K. Digby, and others'.⁸⁷ Two years later Ward, once again, praised 'illustrious' Digby and White in the same breath as Gassendi, and described the two Englishmen as praeclarissimi.⁸⁸ John Wallis, the Oxford mathematician dedicated his Commercium epistolicum to Digby and included in it a letter fulsome in its praise of Digby and declaring that he, Wilkins and Ward were all 'deeply indebted to M. White'.⁸⁹ Ralph Bathurst, Fellow of Trinity, has also been recorded giving high praise to Digby and White.⁹⁰

Gratifying though these praises must have been, it is clear that they did little to serve the Blackloists'

great purpose. Evidently something more had to be done and in 1655 White made his boldest attempt to ingratiate the Blackloist cause to Oliver Cromwell. In that year he published a political treatise entitled The grounds of obedience and government.⁹¹ This work purported to give a strictly rationalist account of the circumstances under which a government should be obeyed and when it should not. White argued that although people prefer to make their own choices about how to act, lack of time and expertise, and the complexities caused by living in large communities made it expedient to entrust certain decisions to others. This delegation of responsibility is voluntary and derives from self-interest. Men are best governed when they are themselves convinced of the rightness of the course of action outlined for them. So the governors should aim at what is best for the people.⁹² Under these conditions obedience is justified and desirable, but the governors must not exceed or abuse their power. White defines government, then, as 'a power or right of directing the common affaires of a multitude, by a voluntary submission of the communities wills to the will of the Governours'.⁹³ If, however, the governors should cease to serve the best interests of the people then a revolution to depose that government and replace it with another is justified. Furthermore, White even declares that it is reasonable to kill the dispossessed governour if he is threatening a revenge which is not consonant to the public good.⁹⁴ For, 'when ever ...

the common good is clearly on the possessor's side then the dispossessed hath no claime'.⁹⁵ Inspired largely by the rationalist politics of Hobbes, the motivation behind this work is perfectly obvious.

Clearly, White was engaged in a blatant attempt to demonstrate to the Lord Protector that Blackloist Catholicism could be counted upon to back him if he granted toleration to this new reformed Church. It hardly needs saying that it all came to nothing. The mistrust of Catholics was evidently so deep-seated that no matter how far White travelled away from the doctrinal norms of the church of his priesthood, he still could not win toleration. What is more, making his political intentions as obvious as he did in The grounds of obedience, he had very definitely put all his eggs in one basket. When, in 1660, King Charles II ascended his father's throne, White's political views were, to say the least, extremely embarrassing. He had expressed himself so clearly and so forcefully that it would have availed him nothing to rescind his views on government. Digby, in spite of all, was still Chancellor and friend to Henrietta Maria but even he was compromised now by his association with White, and never really gained the new King's favours.⁹⁶ Blackloism as a movement, continued its campaigning but White himself retreated increasingly into the background.⁹⁷

In view of the virulence of anti-Catholic feeling in England during the Interregnum and the Restoration it

is hardly surprising that Digby and White failed to persuade their fellow countrymen that they had rediscovered the true faith. Indeed, the Jesuit scholar, R.I. Bradley has forcefully argued that the Blackloists unwittingly eroded what remained of the Catholic Church in England and brought it to its final collapse.⁹⁸ One further irony is the fact that no matter how far they compromised themselves in the eyes of their Mother church, Digby and White were still regarded fearfully as Catholics by English Protestants. In spite of the willingness of the Blackloists to deny the secular power of the Pope, and in spite of White's explicit denial of Papal infallibility in his Tabula suffragiales of 1655,⁹⁹ Digby was still said to have 'pursued nothing with so much vehemence as the establishment of Popery in England', and Thomas White was always regarded as 'the great Papist'.¹⁰⁰

4. Blackloism and Aristotelian atomism.

It may be that the modern reader will simply suppose that White and Digby were out and out opportunists, willing to sacrifice any Catholic doctrine in order to gain toleration for their fellow communicants. If this were so, however, we would have to ask ourselves why they should have bothered to retain the name of Catholic. If they were willing to sacrifice so much of the doctrine, why not sacrifice the name also? In fact, the only way to do justice to the Blackloist programme is to see it

as a major development within a particular tradition of counter-Reformation theology. There were many Catholic thinkers who believed that the counter-Reformation should not be simply a negative reaction to the Protestant Reformation, seeking merely to restore the pre-Lutheran supremacy of the Roman Church. Such men envisaged the counter-Reformation as a new reformation of the Apostolic Church from within. A successful reform would rediscover and re-establish the true faith, which, by definition, would be unique and would once again be accepted by all Christians. If we see the Blackloists in this light it is possible to make sense of their activities.¹⁰¹ They saw no contradiction in arguing for the truth of certain typically Protestant beliefs while still insisting upon the general supremacy of Roman Catholicism. After all, the Blackloists could only be sure they had recovered the true faith of primitive Christianity because it accorded (so they thought) with the three epistemological principles of Catholicism: scripture, tradition, and reason.

It should now be recognised why White and Digby based their natural philosophy upon Aristotelian principles. For them, Aristotelianism was one of the traditions of the Catholic Church. In spite of their close association with original thinkers like Hobbes, Descartes, and Gassendi, they wanted to eschew originality and to

pretend that their advanced mechanical philosophy was all to be found in Aristotle's works. So when Hobbes wrote that 'Aristotelity' was nothing other than 'a handmaid to the Romane Religion', he took it as a sufficient reason to reject Aristotle.¹⁰² For Digby and White, however, it was necessary, on the same assumption, to re-emphasise Aristotle. Just as Catholic theology was always inextricably linked with Aristotelian philosophy, Digby and White judged it fitting, and even inevitable, that their reformed Catholicism should be inextricably linked with their reformed Aristotelianism. In both areas there was nothing arbitrary about their reforms. Their natural philosophy, as much as their theology was guided by tradition as well as by reason.

Fairly detailed outlines of Digby's Treatise on body, showing its indebtedness to Aristotle, have been provided elsewhere¹⁰³ and we need not repeat it here. Suffice it to say that while working almost entirely within an Aristotelian framework, Digby developed a heuristic system which has justly been described as 'impeccable' according to the precepts of the mechanical philosophy.¹⁰⁴ In essence Digby expounded what might well be called 'Aristotelian atomism'. This may seem a peculiar hybrid but Digby himself tried to pass it off as a thoroughbred:

Let any man read his [Aristotle's] books of Generation and Corruption, and say whether he

doth not expressly teach, that mixtion (which he delivereth to be the generation or making of a mixt body) is done per minimum, that is in our language in one word by atomes.¹⁰⁵

According to Digby's exegesis, Aristotle professed that the natural qualities which arose from the combination of elements were brought about:

by the mingling of the least partes or atomes of the said Elements, which is in effect to say that all the nature of bodies their qualities and their operations, are compassed by the mingling of atomes: the showing and explicating of which hath been our labour in this whole Treatise.¹⁰⁶

Unfortunately, the fact that Digby chose to develop his quasi-atomistic mechanical philosophy within the framework of Aristotelianism has tended to obscure his undoubted significance. There has been a tendency to see Digby as a hidebound, old-fashioned thinker, fighting a rear-guard action at a time when all the major natural philosophers were trying to undermine and overthrow Aristotle.¹⁰⁷ Such an attitude involves a rather simplistic assessment of the so-called scientific revolution even in general terms,¹⁰⁸ and with regard to the revival of atomism in the early modern period it is completely misconceived. For, thanks largely to the researches of Andrew van Melsen, we now know that one of the major factors in the revival of quasi-atomistic or corpuscularian matter theories in the early modern period was the Aristotelian tradition of minima naturalia.¹⁰⁹ If we accept Van Melsen's conclusion about the over-riding importance of this Aristotelian

tradition then we can no longer regard Digby as a reactionary thinker. Rather his work must be seen as the culmination of this minima naturalia tradition.

The tradition essentially originated from a particular interpretation of one of Aristotle's refutations of earlier thinkers. In the fourth chapter of Book I of the Physics, Aristotle examined the matter theory of the pluralist philosopher Anaxagoras. Like Democritus, Anaxagoras tried to find a way past the Eleatic elenchus, and the arguments of Zeno.¹¹⁰ Essentially, his matter theory relied on two features. Firstly, he made it axiomatic that matter could be divided infinitely and yet still retain some magnitude.¹¹¹ And secondly, he avoided the Eleatic objection that change involved the coming-to-be of what previously had not existed, by insisting that everything contained 'seeds' or small particles of every other thing. Change, therefore, simply involved the re-mixing or 'sifting-out' of the different 'seeds' of thing.¹¹² This second suggestion seemed possible to Anaxagoras because of his first principle: the seeds of all things could be in each individual object providing that the seeds were infinitely small. Aristotle differed.

If we try to sift out one of the things, say flesh, contained in water, then there can only be two results, Aristotle claimed. Either the last particle of flesh

will eventually be removed from the water, in which case it is no longer true that there is 'a portion of everything in everything'. Or the sifting process will go on indefinitely. In that case, however, as each part of flesh has some definite magnitude, it will be possible to extract a quantity of flesh greater than the original quantity of water. This is, of course, impossible.¹¹³ As a result of this argument Aristotle insisted that 'neither flesh nor bone nor anything of the kind can be great or small beyond limit'.¹¹⁴

This small hint was seized upon by subsequent philosophers and developed into a vigorous aspect of Aristotelian natural philosophy. Andrew van Melsen has traced the beginnings of minima tradition as far back as the commentator, Alexander Aphrodisias, who flourished about 200 A.D.¹¹⁵ Subsequent Greek commentators often followed Alexander but it was the Arabic thinker, Ibn Rushd, known to the West as Averroes (1126-1198), who gave the tradition a new emphasis. Averroes often spoke as though the minima have some sort of autonomous existence. That is to say, Averroes seemed to imply that the minima are present in bodies as actual minima. Aristotle, of course, merely believed they had a potential existence.¹¹⁶

It was mainly among the Latin followers of Averroes, then, that the tradition developed. With the increased interest

in Averroism during the sixteenth century this particular tradition also received a new impetus.¹¹⁷ By the end of the century it seems to have become established as part of the standard interpretation of Aristotle's philosophy. Francisco Toletus (1532-1596), a Jesuit scholar, averred that by his time all authors agreed 'that miscibles are divided into natural minima'.¹¹⁸

It is only a very short step from this position to a more overtly atomist stance. Van Melsen has illustrated the increasing affiliation between the minima naturalia tradition and the recently revived knowledge of ancient atomism in the work of men like Julius Caesar Scaliger (1484-1558), Jean Bodin (1530-1596) and others.¹¹⁹ Van Melsen pointed to Daniel Sennert (1572-1637) as the last representative of the minima naturalia tradition and there can be no doubt that Sennert was an important figure in the revival of atomism, particularly in England.¹²⁰

Nevertheless, it must now be recognised that the Aristotelian minima naturalia tradition found its most original expression, after Sennert's death, in the works of Sir Kenelm Digby and Thomas White. It was the Blackloists who were to take this tradition as far as it was to go and invest it with renewed vigour. When seen from this perspective, the Treatise on body would seem to show that the mechanical philosophy, in its early stages, owed as much to Aristotelianism as it did to Descartes and Gassendi.¹²¹

Just as Digby and White believed it was possible to reconstruct the true faith by judicious use of tradition and reason, so they believed all the problems of natural philosophy could be solved by the traditions of Aristotelianism and the reasoning of what White referred to as the 'Digbaean method'.¹²²

This infallible combination was suggested by White as the sure answer to all sceptics. In his polemic with the Anglican Joseph Glanvill (1636-1680), arising from the latter's Vanity of dogmatizing,¹²³

White insisted that scepticism was the 'Mother of Infinite Errors and all Heresies, and that very seducing Philosophy and vain fallacy which the Saints warned by the Apostles, have taught us to beware of'.¹²⁴

Aristotelianism applied with the Digbaean method, however, could solve all the problems of natural philosophy: the causes of motion, gravity, light, colours and so on.¹²⁵ More importantly, the same combination could also solve all the problems of the nature of the soul.¹²⁶

Joseph Glanvill's response, as we might expect from an Anglican, was to deny the validity of White's 'tradition':

If Aristotle taught the Digbaean philosophy ... he taught the atomical, which is notoriously known to have been the way of Democritus and Epicurus, which Aristotle frequently and professedly opposeth.¹²⁷

Nevertheless, White adhered to his Catholic principles. He believed he had found the way to refute all sceptics and to establish incontrovertible truth. He was confident in this belief because it seemed to him that his philosophy did not deviate from the Scriptures,

from the early traditions of the Church and its (Aristotelian) philosophy, or from the dictates of the most rigorous logic.¹²⁸

5. Blackloism and the implications for seventeenth-century historiography.

The Blackloist counter-Reformation programme was an interesting development in its own right and would repay further study. Already, however, we should be able to see that one or two currently cherished historiographical positions need to be qualified in the light of this Catholic contribution to the early development of mechanism in England.

For example, although it is true to say that the Blackloist programme provides confirmation, from an unexpected quarter, of the importance of eschatological concerns during the period, it cannot be used to confirm Charles Webster's interpretation of how science and eschatology were affiliated.¹²⁹ Essentially Webster's argument is that eschatological considerations stimulated scientific development as an important means towards 'social and intellectual progress'. Eschatology, therefore, is married to Baconianism in Webster's historiography and is said to promote 'the technical, utilitarian and ethical dimensions of science'.¹³⁰ Now, Webster is only able to argue along these lines because he has concentrated on one rather special aspect of eschatology.

Throughout The Great Instauration Webster insists that 'Puritans' were expecting an imminent millennium: a thousand year rule of the Saints on earth during which time society would be transformed into a utopian paradise. The puritans, therefore, turn to Baconian utilitarian science as a necessary first-step towards the establishment of this utopian society.

In fact, Webster's argument relies for its force on an unfortunate failure to distinguish between two eschatological traditions. The millenarianism of which Webster speaks is only a very specialised version of more general ideas which should be called 'apocalyptic'. Admittedly there were those in seventeenth-century England who looked forward to an imminent paradise on earth, where all social injustice would be eradicated for a thousand years prior to the final Judgement Day. These thinkers were millenarians in the true sense, and it may well be that the major motivation behind such beliefs was, or gave way to, a desire for political reform.¹³¹ However, the label 'millenarian' is all too often applied to other thinkers who (being happier with the status quo perhaps) recognised the dangers inherent in such political cravings and who preferred to believe that the millennium was long past, or well under way, and even nearing its end.¹³² Such thinkers, secure in their self-conscious piety, looked forward to the Day of Judgement itself, not what they would see as the more lowly aim of a political utopia. Their views are more correctly labelled as apocalyptic but amillennial.¹³³

Unfortunately we do not have a census detailing which (or even how many) seventeenth-century thinkers were millennialist and which amillennialist. However, it is perfectly clear that the Blackloists were amillennialists. Their concern is only with the state of the human soul after death and after the resurrection of all the dead on the Last Day. There is absolutely no talk of a thousand year rule of the Saints on earth before the Judgement Day. So, it would be short-sighted (not to say blinkered) in the extreme to suppose that the Blackloist mechanical philosophy must have been developed in order to improve man's lot on earth, as a first step to the founding of a utopian society. On the contrary, the Blackloists were concerned with a much more rarefied objective: the establishment of the true faith. They wanted to show that the bodily resurrection, foretold in the scriptures and emphasised in the early traditions of the Church, was in keeping with the other rule of faith - reason. Their mechanist physics was developed, then, in order to give philosophical backing to the concept of the resurrection. Their natural philosophy affirmed that the resurrection of the body was not only philosophically sound but philosophically necessary.

Similarly the other leading figure in the early development of the mechanical philosophy in England, Thomas Hobbes,

also paid great attention to eschatological concerns. In the final part of Leviathan Hobbes discussed the immortality of the soul and the state of affairs after the Last Judgement. There is, however, no discussion of the millennium.¹³⁴ Indeed, perhaps it should be added that the prevalence of mortalism during this period tends to suggest that a significant number of thinkers from John Donne and Thomas Browne to Richard Overton, Hobbes and Milton were more concerned with the Last Day than they were with any thousand year preamble.¹³⁵

Providing we bear in mind the distinction between true millenarianism and more general apocalyptic ideas, millenarianism begins to seem less significant than Webster would have us believe. Because Webster believes that most seventeenth-century natural philosophers are simply millenarian, and therefore expecting some sort of political utopia under the rule of the Saints on earth, then it makes perfect sense for him to suppose that they were fired to develop a utilitarian science which then became an indispensable feature in the march of progress. However, if we take the more correct view that most natural philosophers in the period were anticipating the Day of Judgement when all social and political aspirations would be suspended once and for all, then Webster's supposition seems far less persuasive.

In the conclusion to The Great Instauration Webster claims that he has tried 'to explore the relevance of Puritanism to the investigation of the natural world in terms of contemporary priorities'.¹³⁶ It would seem that he has not quite lived up to this ambition. In fact he has exaggerated the role of political utopian motivations (presumably his own priorities) at the expense of more strictly religious motivations. The Millenarian-utilitarian-utopian tradition which Webster has charted was undoubtedly significant, but injudicious use of the word 'millenarian' should not be allowed to obscure a separate tradition.¹³⁷ That there was a profound interdependence between apocalyptic (but amillennial) eschatology and the mechanical philosophy is clearly shown by the work of Digby and White. But their work is only the earliest in a tradition later adopted, or rather adapted, by thinkers like Robert Boyle, John Evelyn, Thomas Burnet and others.¹³⁸

The Blackloist programme also tends to confirm the belief of many historians that the mechanical philosophy and its associated corpuscularian matter theory were first introduced into the main-stream of English natural philosophy in order to promote a particular ideological purpose. However, the fact that the ideology of Digby and White was neither Puritan, Latitudinarian nor Anglican

means that the prevailing historiography has to be qualified yet again. With the addition of Catholicism to these other three religious ideologies it now seems even more obvious than it did before that the mechanical philosophy could be (and was) used to provide a philosophical foundation for almost any ideological standpoint.

It follows that the recent attempt to argue exclusively for 'the Anglican origins of modern science' by establishing 'the relation of matter theory to ideology' in the work of Robert Boyle during the Restoration period is totally inadequate.¹³⁹ It can now be seen that Boyle merely had to follow the example set by Digby and White. The Blackloists had demonstrated clearly and explicitly how science could be used for ideological purposes long before the Restoration and it was all there for the taking. There can be no doubt that Boyle knew the work of these two Catholics. Digby had ingratiated himself to Samuel Hartlib in the early 1650s and may well have entertained hopes that the Blackloist theology would hold some appeal for Hartlib's circle, who were also keen to establish a unified Church.¹⁴⁰

The fact that the earliest overt attempt to use natural philosophy for ideological purposes was perpetrated by counter-reforming Catholics may also add to our under-

standing of the very real mistrust of the new philosophy shown by many thinkers. Among the factors which historians have already discerned in this mistrust are a reaction against the dogmatism of Descartes and Hobbes which seemed at the time to lead to materialism and atheism; and a reaction against the various kinds of natural philosophy which became associated with various radical and subversive sects in the revolutionary period.¹⁴¹ No historian could deny, however, that for most seventeenth-century Englishmen Roman Catholicism presented at least as big a threat to their society as atheism or enthusiasm.

It may well be, therefore, that some of the suspicion directed against the new science stemmed from the knowledge that the Catholics were using it to promote their own religious and political ends. In the light of this, the remarkable attacks upon the new science by Henry Stubbe (1632-1676) and Thomas Barlow (1607-1691) no longer seem so peculiar or so surprising.¹⁴² In a series of pamphlets, published in 1670, Stubbe vilified the Royal Society on a number of grounds but the charge that the Society was a crypto-Catholic enclave has always seemed the most outlandish. Nevertheless, considering the anti-Catholic feelings that raged throughout the Restoration period, Stubbe's suggestion that the Royal Society was bent on introducing 'a

Popish implicit faith' may well have been the most damaging of his attacks.¹⁴³ Stubbe spelled out the reasons for his belief in Campanella reviv'd.¹⁴⁴ He alleged that the encouragement to study natural philosophy (which the Society indulged in) was a plot to distract the greatest minds while the Roman Church sought to re-establish itself.¹⁴⁵ It is quite clear that he associated the Blackloists with such plots because he referred explicitly to 'the doctrines of Mr White, Dr Holden, Serenus Cressy, and such others as endeavour at present (and that with great show of wit and artifices) to seduce the English to that Apostaticall Church'.¹⁴⁶ Although White was never a fellow of the Royal Society, Sir Kenelm Digby was and Stubbe made a point of singling him out to denounce him as 'the Pliny of our age for lying'.¹⁴⁷

Five years later, Thomas Barlow, soon to become Bishop of Lincoln, wrote to a friend that he was:

not a little troubled, to see Protestants, nay Clergy-men and Bishops, approve and propagate, that which they miscall New-Philosophy; so that our Universities begin to be infected with it, little considering the Cause or Consequences of it, or how it tends evidently to the advantage of Rome, and the ruine of our Religion.¹⁴⁸

Like Stubbe, Barlow believed that 'this New-Philosophy as they call it) was set on foot, and has been carried on by the Arts of Rome'. Barlow believed that the use of philosophical argument to bolster religion was bound

to cause confusion and division. Rome had capitalized on this kind of confusion by promoting the study of natural philosophy in England and Holland where divisions in religion were manifold.¹⁴⁹

I believe that Barlow's and Stubbe's profound suspicion of any attempt to use natural philosophy to promote particular theological doctrines is typical of orthodox English thought from the days of the Protectorate to the turn of the century. The evidence seems to suggest that most English intellectuals would have implicitly agreed with Barlow that confusion and dissent was as likely to ensue from this kind of ideological use of natural theology as unanimity and peace. In subsequent chapters of this thesis I hope to show that the major proponents of the new philosophy in England were aware of the dangers of such ideologically directed science. The dogmatism of Descartes, of Digby and White, or of Hobbes could lead, whatever the intentions of their authors, to atheism, fanatical sectarianism, or Roman Catholicism. The only safe way to avoid such abuses in natural philosophy was to follow the lead taken earlier by orthodox Protestant divines who also wished to avoid the pit-falls of Romanism, enthusiasm and atheism. In the early decades of the seventeenth century, Anglican intellectuals had responded to the various controversies about the 'rule of faith' - that is to say, the criteria by which one could judge what it was

safe to believe - by developing a position which has been aptly called 'constructive scepticism'.¹⁵⁰ Similarly, the mainstream of English natural philosophy developed a methodology based on constructive scepticism. The **dogmatic** stance of the Blackloists, no less than that of Hobbes and even Descartes, was thoroughly repudiated. But the story is complex and to demonstrate this will be part of our task in subsequent chapters.

6. Sir Kenelm Digby and the principle of motion

We must return now to our earlier theme and ask ourselves how - in his efforts to account for all phenomena in terms of matter and motion - Digby first of all accounts for motion itself. We noticed earlier that one commentator has regarded Digby's natural philosophy as 'impeccable' in its adherence to the canons of the mechanical philosophy.¹⁵¹ We must now modify this judgement by pointing out that although Digby explains all physical phenomena in terms of matter in motion, his philosophy by no means matches up to the stricter requirements of Cartesian mechanism. For, as we shall see, Digby's Treatise on body, like Hobbes' Little treatise relies heavily on a self-active agent as the motor for all other changes.

It is only at a superficial glance, therefore, that Digby's mechanical philosophy seems 'impeccable'. Certainly, as we have seen, he considers it of the utmost importance (indeed essential) to do away with all explanations

in terms of occult qualities.¹⁵² In particular he rules out all suggestions of action at a distance:

action among bodies is performed for the most part by the emission of little parts out of one body into another, as also that such little parts can not steame [sic - 'stream'?] from the body that is their fountaine and settle upon a remote body without passing through the interiacent bodies, which must furnish them, as it were, with channels and pipes to convey them whither they are to go¹⁵³

Nevertheless, we must ask ourselves why it is that 'little parts' do stream (or steam!) out of bodies - as water out of a 'fountaine'. Are we to conclude that Digby, like Hobbes, believed in bodies with 'inherent power to move'?¹⁵⁴

Generally speaking, the answer to this question is no. In a number of examples in the Treatise Digby provides a physical explanation for the continual streaming of 'little parts' out of bodies. However, all of these examples rely on an unexplained motive principle. This self-active principle (for such we must conclude it to be) is light. We need not be surprised at this. After all, Digby's close friend, Hobbes, had already invoked light as an active principle in his Little treatise. Furthermore, we have seen that a number of Hobbes' major sources for this notion came from Digby's own collection of manuscripts.¹⁵⁵ It is hardly surprising, therefore, that Digby should rely on the tradition of light metaphysics to enable him to solve the crucial problem of the successive origins of the various motions

occurring, ceasing and recurring in the World. Indeed, in view of the reverence Digby shows for the early traditional beliefs of his Church, he seems a much more likely advocate of light metaphysics than Hobbes.¹⁵⁶

After an initial 'Preamble', Digby, not unnaturally, begins his Treatise on body by establishing the nature of matter. Starting from a truly ingenious blend of Aristotelian and mechanical first principles, Digby manages to conclude that 'There are but foure simple bodies: and these are rightly named Elements'.¹⁵⁷ The mechanical philosophy has been pressed into service, therefore, to establish the reality of the traditional Aristotelian elements. Having demonstrated the existence of the four elements Digby goes on to consider 'their Activities compared with one another'.¹⁵⁸ It is here that we find the first hints of activity within matter. Compared with earth and water, Digby tells us:

fire is more active than either of them; as it will appeare clearly if we consider, how when fire is applyed to fewell, and the violence of blowing is added to its own motion; it incorporateth it selfe with the fewell, and in a small time converteth great part of it into its own nature, and shattereth the rest into smoke and ashes.¹⁵⁹

Subsequently, Digby explains how fire 'cometh out of fewell and worketh upon other bodies'. Fire breaks out of a piece of fuel (the process we would call

ignition) principally because 'the activity of that fierce body, will not let it lye still and rest'.¹⁶⁰

So, during the heating process more and more particles of fire are incorporated into the fuel, but this process:

doth so exceedingly condense them into a narrower roome than theire nature affecteth, that as soon as they gett liberty, and grow masters of the fewel, (which at first was theire prison) they enlarge theire place, and consequently come out and flye abroad; ever ayming right forwardes from the point where they begin theire journey: for the violence wherewith they seeke to extend themselves into a larger roome, when they have liberty to do so; will admitt no motion but the shortest, which is, by a straight line.¹⁶¹

What Digby is describing here is a process of auto-diffusion. Just as the light metaphysical tradition regarded the ability of light to spread itself out, spontaneously from a point source, as its most characteristic property, so Digby suggests:

the most simple and primary motion of fire, is a fluxe in a direct line from the center of it, to its circumference.¹⁶²

It comes as no surprise, therefore, to see Digby following up this account of fire with a lengthy discussion of the nature of light.¹⁶³ Only after this does he feel fully equipped to embark upon an exposition 'Of local motion'.¹⁶⁴

For Digby fire and light are simply denser and rarer manifestations of the same corporeal entity. It is at this point in his system that Digby has to admit to a divergence from the beliefs of his beloved Aristotle.

As Digby is all too well aware, Aristotle 'leadeth the daunce to hold light a quality, and mainly to deny it any bodily subsistence'.¹⁶⁵

Aristotle was led to his belief that light was a state or quality of the medium because it appeared that light simply could not be material. Principal among the arguments against the corporeality of light was its alleged instantaneous propagation and its simultaneous existence in the same place as other bodies, such as air or glass. Digby had no difficulty refuting the latter argument:

the ayre being a very divisible body, doth without resistance yield as much place as is requisite for light. And that light, though our eyes iudge it diffused everywhere, yet it is not truly in every atome of ayre: but to make us see it everywhere, it sufficeth that it be in every part of the ayre which is as big as the blacke or sight [pupil] of our eye; so that we cannot set our eye in any position whereit receiveth not impressions of light.¹⁶⁶

The instantaneous propagation of light was a rather more tenacious doctrine. It was so strongly held that even Descartes formulated his own concept of light in order to accommodate it, and Hobbes quickly changed his theory of light after writing The little treatise because he could no longer accept his early views about the finite speed of light.¹⁶⁷ Digby, therefore, must be credited as the first mechanical philosopher to insist upon the finite velocity of light. He ventures to predict that

an experimental determination of the speed of light may soon be possible but his own approach to the problem is entirely discursive.¹⁶⁸ Essentially, he argues that it would be impossible to tell in everyday life. Thus, we know that sound travels slowly in comparison to light, he points out, because of familiar phenomena like seeing the flash of a cannon before hearing it:

But shut your eyes [he continues], or enquire of a blind man, and then neither you nor he can tell whether these soundes fill your eares at the very instant they were begotten, or have spent some time in their iourney to you.¹⁶⁹

The traditional argument that we see the sun at the very instant that it appears over the horizon, he dismisses with the contempt it deserves.¹⁷⁰

By these and other arguments Digby insists upon the material nature of light. It is then an easy matter for him to equate it with fire. From this point on Digby invokes light and fire interchangeably as active principles, following other 'Philosophers' in ascribing to these principles 'spheres of activity'.¹⁷¹ Furthermore, the Sun, in Digby's system, becomes 'a constant and perpetuall cause' whose influence 'with his light and beames which reacheth farre and neere' gives fire its 'universal action' but whose own activity remains entirely axiomatic.¹⁷²

There can be no doubt that light is the principle of motion in Digby's system of matter in motion. He makes this perfectly explicit when giving a summary of the nature of light:

it beginneth from a little source; and by extreme multiplication and rarefaction, it extendeth it selfe into a great sphere. And then we will perceive the reason why light is darted from the body of the sunne with that incredible celerity, wherewith its beames flye to visite the remotest parts of the world; and how, of necessity, it giveth motion to all circumstant bodies: since it is violently thrust forward by so extreme a rarefaction; and the further it goeth, is still the more rarefied and dilated.¹⁷³

Later, Digby begins his account 'Of the composition, qualities, and generation of Mixed bodies' in the following way:

Having now declared the vertues by which fire and earth worke upon one an other, and upon the rest of the elements; which is, by light Our taske shall be in this chapter first to observe what will result out of such action.¹⁷⁴

In order to appreciate the really crucial role played by light in Digby's system of philosophy let us consider one of his most striking examples. In Chapter X of the Treatise on body Digby tries to give a mechanistic explanation of the operation of gravity. He begins with an argument from analogy. The action of the Sun on the Earth is said to be like that of a fire applied to a pot of water. Just as the particles of fire break up the water into flying particles of steam, so 'the light [from the Sun] rebounding from the earth with atomes causeth two streames in the ayre: the one ascending, the other descending and both of them in a perpendicular line'.¹⁷⁵ The descending flow is caused by the principle of fuga vacui, to replace the

ascending particles. It is this descending flow which pushes objects down and accounts for the force of gravity. Of course, Digby is aware that he must account for the fact that the downward stream of atoms is more forceful than the upward stream. Unfortunately, his plausibility becomes somewhat strained at this point.

The downward stream is more forceful because it is more dense. Why is the upward stream less dense (after all, the whole scheme is based on a circulation and so should involve the same kind of particles in both directions)? Digby's answer relies on the notion that the upward flow consists of particles which are combined with the particles of light which broke them loose. Digby envisages this as similar to a tennis ball bouncing against a wall with wet mortar. The ball will rebound off the wall with some of the mortar sticking to it. So a particle of light bounces off the earth with some moist parts of the earth sticking to it. The density of this ascending particle is now 'to be esteemed according to the density of the two parts', and light is the rarest corporeal entity. Eventually (at great heights) the light particles break away from their atomic partners:

and thereby, the bulke of the parte which is left, becometh of a different degree of density (quantity for quantity) from the bulke of the entire atome, when light was part¹⁹⁸ of it; and consequently it is denser than it was.¹⁷⁶

Even if this is granted it could still be objected that such invisibly small particles would not descend as quickly as a large heavy object and so could hardly be the cause of its descent. Here, Digby brings in a familiar Aristotelian device:

... the very descent of it [the object] occasioneth their striking it, for as it falleth and maketh itself a way through them, they divide themselves before it, and swell on the sides and a little above it, and presently close again behind it and over it as soone as it is past. Now that closing to hinder vacuity of space is a sudden one, and thereby attaineth great velocity which could carry the atomes in that degree of velocity further than the descending body¹⁷⁷

Traditional Aristotelianism, of course, distinguishes between the natural motion due to gravity and the unnatural motion of a projectile. Digby has quite simply recognised that the doctrine of antiperistasis, usually invoked to explain projectile motion, is perfectly compatible with the precepts of the mechanical philosophy. He does not hesitate, therefore, to apply this doctrine to a body in free-fall and so immediately dispose of the 'occult' explanations of fall used by the scholastics. This example is only one of many which demonstrate Digby's agility of mind and his truly original and yet undeniably Aristotelian approach to problems of natural philosophy.

Even so there are still some nagging doubts left in the mind of the reader confronted with Digby's explanation

of gravity. For one thing, gravity has been invoked earlier in the Treatise in order to define the very nature of a dense body. But now we find gravity being explained in terms of the impact of dense particles.

However, Digby is fully aware of this problem:

In our investigation of the Elements, we tooke for a principle thereunto that gravity is sometimes more, sometimes lesse, than the density of the body in which it is. But in our explication of ... gravity, we seem to putt that gravity and density is all one.¹⁷⁸

Digby's resolution of the problem is quite significant and worth remarking:

We are therefore to consider, that density (in it selfe) doth signify a difficultie to have the partes of its subject in which it is, separated one from an other; and that gravity (likewise in it selfe) doth signify a quantity, by which a heavey body doth descend towardes the center; or (which is consequent thereunto) a force to make an other body descend. Now this power, we have shewed, doth belong unto density, so farre forth as a dense body being stricken by an other, doth not yield by suffering its partes to be divided; but, with its whole bulke striketh the next before it, and divideth it, if it be more divisible than it selfe is. So that you see, density hath the name of density, in consideration of a passive quality or rather of an impassibility, which it hath; and the same density is called gravity, in respect of an active quality it hath which followeth this impassibility.¹⁷⁹

Digby's distinction between an active and a passive quality in this passage has an ancient pedigree but in the context of a mechanical philosophy the distinction takes on a new life. It may well be that this distinction influenced Isaac Newton's own extremely complex conception of force. For Newton's concept of force is by no means a monolithic concept. In the opening

pages of Newton's Principia mathematica he refers to a passive vis insita and a more active vis impressa and refers to gravity as a 'centripetal force' which he defines in a way strikingly similar to Digby's own definition just quoted: 'A centripetal force is that by which bodies are drawn or impelled ... towards a point as to a centre'.¹⁸⁰

The probability that Newton's general conception of force owes something to Digby's Treatise on body is enhanced when we remember that Newton's early note-book, entitled Questiones quaedam philosophicae contains detailed notes taken from it. In particular, Newton wrote at length about Digby's explanation of gravity.¹⁸¹ Furthermore, Digby's Treatise on body has been proposed more than once as a likely source for another important aspect of Newton's conception of force: the notion that 'To every action there is always opposed an equal reaction'.¹⁸² It is my contention that these matters taken together argue strongly for the influence of Digby not just on Newton's third law of motion but upon his more general conception of the nature of force.

We need not try to pursue any further the possible influence of Digby upon Newton - no doubt the suggestion can never be demonstrated more forcefully. Our point in concentrating on this particular example of Digby's natural philosophy

is to show how crucial and fundamental the behaviour of light is to Digby's explanatory scheme. Even such a universal problem as the descent of bodies due to gravity is in Digby's scheme, entirely dependent on the activity of particles of light. It is impossible to deny that light, for all its corporeality, plays a fundamental metaphysical role in Digby's physics.¹⁸³

The early history of the mechanical philosophy in England, then, was intimately bound up with the much older tradition of light metaphysics. Walter Warner's system remained in manuscript and known only to a few, and Hobbes chose not to proceed to publication with the same 'first principles' he outlined in his Little treatise. It is only in Sir Kenelm Digby's Treatise on body that these ideas were made public. By this time, of course, the much more rigorous system of Descartes was becoming well-known. Descartes' system did not rely on an unexplained perpetual source of activity like the Sun, nor what might well be regarded as an 'occult' belief in the autodiffusion of light. To Hobbes, at least, the light metaphysical version of the mechanical philosophy seemed already to be superseded.

It is my belief that Hobbes' realisation of the superior

logical coherence and rigour of the Cartesian system, together with his own bitter rivalry with Descartes caused him to delay publication until he felt he could match, or rather better, the Cartesian system. Digby's priorities, however, lay elsewhere. For Digby the important thing was to establish the immortality of soul and to set in train the Blackloist plan for ecumenical Church reform. We return now to consider the development of the mechanical philosophy in the work of Hobbes. First of all, however, we must consider his likely reaction to the ideological efforts of his Catholic friend.

CHAPTER 4

THE FAILURE OF STRICT MECHANISM IN ENGLAND:

THOMAS HOBBS AND DE CORPORE

We have seen that the Blackloists, particularly Sir Kenelm Digby and Thomas White, made the ideological use of the mechanical philosophy perfectly explicit.¹ From now on we shall have to consider the role played by ideological factors in the subsequent development of the mechanical philosophy in England. Each chapter, therefore, will begin with a survey of the ways in which our protagonists used the mechanical philosophy to promote a particular ideology or, if appropriate, how they reacted against the ideological use of natural philosophy. There are two reasons why this kind of investigation is essential here. Firstly, there can be no doubt that the particular forms that the mechanical philosophy took and its predominant methodology² were conditioned by ideological factors and the reactions to them. Secondly, this has now become a major feature - perhaps the major feature - in the historiography of the subject and so can hardly be ignored. The first part of this chapter, therefore, will concentrate on Hobbes' attitude to the use of the mechanical philosophy for religio-political purposes. After all, there can be no denying Hobbes' pre-eminence as a political ideologue, and a number of scholars, as we shall see, have supposed that Hobbes' political doctrines grew out of his materialistic natural philosophy.

In the second section we will continue the story which we began in Chapter 2. I will argue that the reason for Hobbes' failure to publish his system of mechanical philosophy before 1655 was his inability to dispense with unexplained, active principles. Before the completion of De corpore in its published form, Hobbes' natural philosophy did not match up to the rigorous standard set by Descartes' strict mechanism. Only during the last few years before the appearance of De corpore in print did Hobbes feel that he could explain all physical phenomena in terms of the actions, reactions and interactions of inert, passive matter set in motion at the Creation by the 'Author of Nature'.³ However, I hope to show that in spite of Hobbes' own confidence about the strictness of his mechanical theories he satisfied no-one else. Hobbes' strict version of the mechanical philosophy, therefore, must be counted as a failure.

In the final section of this chapter I try to further illustrate my suggestion that the early development of the mechanical philosophy owed much to the ideas perpetuated in the Hellenistic and medieval traditions of light metaphysics. I hope to do this by pointing to a parallelism between the early careers of Hobbes and Descartes. Remaining with this comparison between these two thinkers I endeavour to show that Hobbes' concept of 'endeavour' or conatus once again reveals

a flaw in the 'strictness' of Hobbes' philosophy - revealing hints of animistic thinking. Finally, I argue that the late appearance of Hobbes' system gave him one advantage over his French rival, by enabling him to take into account Kepler's first law of planetary motion which Descartes had overlooked.

1. Hobbes and the ideological use of natural philosophy.

There is undoubtedly a sense in which Hobbes was using his natural philosophy to promote his political doctrines. However, I believe this is true only in a trivial sense when compared to the endeavours of the Blackloists. Admittedly, Leviathan⁴ is shot through with Hobbes' materialist views and the rationalist approach which Hobbes employs to establish his political principles is essentially equivalent to his rationalist method in natural philosophy. However, it is not possible to extend these links between his science and his politics any further. Hobbes compared his own achievement, as founder of 'Civil Philosophy', in De cive with the achievements in natural philosophy of Copernicus, Harvey, Galileo, Kepler, Gassendi, Mersenne and 'the College of Physicians in London'.⁵ It would be ludicrous to suppose from this comparison that Hobbes' political ideas were closely indebted to details of the natural philosophy of any, much less, all of these men. The comparison is simply between levels of achievement and may possibly suggest some methodological affiliation but that is all. I believe that precisely the same is

true of any comparison between Hobbes' political ideas and his own natural philosophy. Indeed, Hobbes makes it perfectly clear that the principles of politics can be derived independently of and without reference to the behaviour of body or matter in general. When Hobbes published De cive prior to De corpore and De homine which should naturally come first, he gave a brief but significant apology:

Therefore, it happens that what was last in order is yet come forth first in time. And the rather, because I saw that, grounded on its own principles sufficiently known by experience, it would not stand in need of the former sections.⁶

Even so, the exact relationship between Hobbes' political ideas and his mechanical natural philosophy is still being debated. It seems that the majority of scholars of Hobbes' thought tend to agree with the late nineteenth-century historian George Croom Robertson that:

however Hobbes might wish by afterthought to connect his theory of political society with the principles of his general mechanical philosophy, ... it sprang originally from a different line of consideration.⁷

Recently the opposite case has been strenuously argued by J.W.N. Watkins and T. A. Spragens.⁸ It seems to me, however, that these ultimately fail to establish their case beyond the acknowledged importance of methodology and a generally materialistic outlook in Hobbes' work.

It may well be that the Watkins-Spragens school of thought,

if we may call it such, would wish to use the phenomenon of Blackloism to defend their case. We have seen that Digby's Treatise on body shows certain fundamental similarities to Hobbes' early work in natural philosophy, and there can be no doubt that White drew heavily upon Hobbes' political writings for his Grounds of obedience and government.⁹ In view of Hobbes' influence upon the Blackloists perhaps we ought to recognise him as the first thinker to use the mechanical philosophy for ideological purposes. Let us consider this.

Certainly Digby and White owe a good deal to Hobbes but it is equally clear that Hobbes gained as much as he gave. The recent discovery and publication of Hobbes' critique of Thomas White's De mundo shows that Hobbes worked out and refined his own natural philosophy during the course of this detailed scrutiny of White's work.¹⁰ It is worth reminding ourselves also that Hobbes was actually accused of taking some of his ideas from Digby by Seth Ward.¹¹ Admittedly this accusation is to be found in the context of a savage attack on Hobbes but there are clear indications that Ward was partially justified with respect to all the other thinkers he cites. We have seen that there is certainly truth in Ward's suggestion that Hobbes took many ideas from 'Mr Warners Papers' and it is well known that the rancour which existed between Descartes and Hobbes was largely due to

Descartes' conviction that Hobbes was plagiarising his ideas, while Hobbes himself acknowledged in private correspondence his admiration for the system of Gassendi.¹²

We are not seeking to undermine Hobbes' reputation and reveal him as a plagiarist. Whatever the influences upon him, his own system is sufficiently different to reject such charges. Nevertheless, it must be recognised that he did not arrive at his system as a result of abstract rational thought without external influence. Indeed we have on record at least one incident which suggests, rather amusingly, that Hobbes was easily led by fellow philosophers. On being shown a geometrical solution by Descartes to a problem about oscillations, Hobbes 'praised it very much at first but after Monsr Robervall doubted if it, Mr Hobbes seemeth to doute too'.¹³ According to Jean Jacquot, Hobbes' change of mind here is 'typical'.¹⁴ It would seem, then, that there was a very free interchange of ideas about natural philosophy at this time and it would be as foolish to dismiss Digby and White as mere plagiarists of Hobbes as it would be to accept the accusations of Ward against Hobbes.

Even so, it could still be argued that Hobbes was the major figure in the transformation of the mechanical philosophy from a convenient heuristic system of

natural philosophy to a philosophically rigorous foundation on which to establish a religious and political ideology. If this is the case then the Blackloist programme has to be seen as a rear-guard action to turn this new (Hobbesian) way of arguing around and to make it serve the ends of Roman Catholicism. Such an interpretation of the Blackloist programme seems unlikely on internal grounds which have already been detailed. But much more revealing in this context is the fact that Hobbes frequently professes himself to be totally opposed to the ideological use of natural philosophy.

The clearest indications of just how much Hobbes differs from the Blackloists in his attitude to ideologically directed philosophy is afforded by Hobbes' own reactions to Thomas White's De mundo. In the third dialogue of the De mundo White addresses himself to problems of natural theology, in which he seeks to establish the existence and some of the attributes of God by means of arguments from natural philosophy. Hobbes is unequivocal in his reaction: 'But our author, or anyone else who promises demonstrations of this kind is not proceeding correctly'.¹⁵ Hobbes goes on to insist that it is not only 'unphilosophical' but also an affront to theology because it implies limitations to God's will or omnipotence, and a sin against religion

because it seeks to replace faith with philosophy even though 'articles of faith' are 'the limbs of religion'.¹⁶

Any attempt to use philosophy to establish theological truths is, for Hobbes, anathema. His main objection is that such an enterprise is dangerous both to the individual soul and to the peace and unity of the Church. Hobbes puts it like this:

... the promises of the Divine Mercy have been given not to philosophers but to the faithful, that is, to those who accept the authority of the Church. To what end, then, should one wish to employ natural reason in enquiring into the articles of faith? For, if reason convince us upon matters that conform to faith, we lose the grace of faith; if upon matters contrary [to faith], not only will you be forced to say one thing and think another, but also you will be less obedient to the authority of the Church; [and to be thus] is against the salvation of the soul.¹⁷

And on the more general level:

For a private person to call for a re-examination of matters that have once and for all been settled and determined by the authority of the Supreme Power is absurd and directly counter to the reasons for the Church's peace and unity. Nay, rulers must strive with the greatest zeal not to allow men to argue out any article of faith, for the belief of countless other Christians will be endangered by the mind of one man.¹⁸

Now it may well be thought that what is revealed here is an unfamiliar aspect of Hobbes' thought. Indeed, until very recently it has generally been assumed that Hobbes was as much of an atheist as any of his contemporary enemies took him to be.¹⁹ The obvious references to religious and theological ideas in Leviathan and his

other works were taken to be either insincere efforts to avoid censure or elaborate efforts at reductio ad absurdum.²⁰ Fortunately, the details of Hobbes' religious beliefs and their undoubted significance for his political thought are now being established.²¹

Hobbes consistently and repeatedly stated that religious dissent was the major cause of civil strife and, in particular, the main cause of the English civil wars.²² In view of his protracted efforts to establish the safest grounds of government in his various political treatises we should expect to find much of his time spent dealing with the means to establish the true Church. This is indeed the case. With every new version of his political philosophy, religion plays an increasingly large part and takes up more space. The culmination of this, of course, is in Leviathan where half of the book deals with religious matters.²³

In order to understand Hobbes' position on these matters, however, it is essential to draw a clear distinction between the practical aspects of Church government and organisation and the abstract theology of religious doctrines. Certainly Hobbes' ideas about the organisation of the Church as an institution are dictated by his political theories. He takes Anglicanism to its logical conclusion, making his absolutist sovereign the

supreme power in Church as well as state. With regard to Church government Hobbes is entirely pragmatic and as with his politics advocates a strong authoritarian rule which countenances no disobedience.²⁴ But this is very different to his attitudes about theological doctrines. With regard to doctrines Hobbes is almost entirely fideistic and it is here that the crucial difference between him and White is manifested.

It should not be forgotten that White too recognised the need for practical political commitments with regard to Church organisation. Although obviously different in detail, there is no difference in approach between Hobbes' efforts to establish a totally Erastian Church, and White's promises to government to set up a Blackloist episcopacy concerned only with spiritual matters, free from all Papal influence, and answerable to the government.²⁵ Hobbes and White had totally different approaches to theological questions, however. White, as we have seen, used philosophy or 'right reason' to establish the doctrines of his faith while Hobbes certainly repudiated any such efforts. For Hobbes, theological beliefs could only be established by scripture. His reaction to the debate between Catholic and Protestant was entirely within one of the oldest traditions of Reformation thought: 'controversy between the Papist and the reformed Churches could not

choose but make every man, to the best of his power, examine by the Scriptures, which one of them was in the right'.²⁶ For Hobbes it was important that we should live 'without mingling our religion with points of natural philosophy'.²⁷

If evidence were needed of Hobbes' sincerity on this matter then surely Leviathan provides it in abundance. Time and again Hobbes considers a particular aspect of belief by a thorough analysis of scriptural pronouncements. In fact the most instructive example of this, for our purposes, is provided by Hobbes' own attempts to establish the truth of his own mortalist or psychopannychist beliefs. Hobbes' approach can be directly compared with that of Thomas White, whose careful philosophical analysis of the nature of changeability, the state of the disembodied soul, and the meaning of eternal torment we have already seen.²⁸

In view of Hobbes' own total rejection of the concept of incorporeal or disembodied spirits it is hardly surprising that he looks forward to a general resurrection in which body and soul will be resurrected to be judged and then suffer punishment or reward. Similarly, he insists that the place of this 'world to come' is simply the earth itself, not a coelum empyreum. However, Hobbes,

unlike White, never introduces his materialist natural philosophy into the discussion. His only concession to the notion that philosophy could be relevant occurs in a single phrase:

That the place wherein men are to live Eternally, after the Resurrection is the ... Caelum empyreum, (whereof there is no mention in Scripture, nor ground in Reason) is not easily to be drawn from any text that I can find.²⁹

But even here, Hobbes is not giving any rational grounds for a particular theological doctrine but is merely making a negative point. Elsewhere he explicitly denies that there can be any natural immortality of the soul but insists that eternal life is only granted by God's grace:

Therefore where Job saith, man riseth not till the Heavens be no more; it is all one, as if he had said, the Immortal life (and Soule and Life in the Scripture do usually signifie the same thing) beginneth not in man, till the Resurrection, and day of Judgement; and hath for cause, not this specificall nature and generation; but the Promise. For St. Peter saies not, Wee look for new heavens, and a new earth, (from Nature,) but from Promise.³⁰

The reasons for this remarkable difference in approach between Hobbes and White are certainly complex and merit a careful exposition in themselves. In brief, it should be pointed out that Hobbes has no need to go to the same lengths as White because he is writing within a tradition (albeit a minor one) of Protestant theology. Luther himself, for whom Hobbes expresses great admiration was a psychopannychist.³¹ Luther denounced the newly

established doctrine of the natural immortality of the soul (decreed at the fifth Lateran Council in 1513) on the grounds that it was inspired by Pagan philosophy (principally the newly discovered philosophy of Plato as expounded by Ficino and others). His insistence that the Scriptural promise of 'eternal life' had nothing to do with a concept of the soul led him to outline his mortalist belief in the resurrection of body and soul together. Hobbes shows himself to be influenced by Luther on this, in the passage quoted above when he says that soul and life in scripture are the same thing.³²

By contrast White is breaking the traditions of his own Church and must, therefore, provide some extra backing from philosophy to justify his departure.

A second difference between Hobbes and White is the former's belief (again reminiscent of Luther) that complex philosophical arguments form part of the deceptive techniques used by the Roman Church to establish the 'Kingdom of Darknesse' over mankind.³³

But probably the most fundamental difference arises from Hobbes' need to allow for authoritarian pronouncement about doctrines which could be contradicted if philosophy were used to analyse them. 'It must not be thought

that the articles of faith are [philosophical] problems', he says, 'they are laws, and it is inequitable for a private individual to interpret them otherwise than as they are formulated'.³⁴ Even during his outline of eschatology Hobbes defers his own ideas to the ipse dixit of the 'Sovereign Power':

... the Kingdom of God is to be on Earth. But because this doctrine (though proved out of place of Scripture not few, nor obscure) will appear to most men a novelty; I do but propound it; maintaining nothing in this, or any other paradox of Religion; but attending the end of that dispute of the sword, concerning the Authority, (not yet amongst my Countrey-men decided,) by which all sorts of doctrine are to be approved, or rejected; and whose commands ... must by all men, that mean to be protected by their Laws, be obeyed.³⁵

It should be perfectly clear by now that Hobbes was extremely suspicious of any attempts to use natural philosophy to establish theological doctrines. In view of his extreme anti-Catholic stance, his knowledge of White and his Blackloist machinations can only have reinforced him in this view. While White took pride in the fact that it was impossible to say where his divinity ended and his philosophy began,³⁶ Hobbes always kept them separate. That he saw his natural philosophy as distinct from his political philosophy is clearly implied by the closing words of Leviathan. He declares that he can now return to his 'interrupted

Speculations of Bodies Naturall' which he believes will be less controversial than his speculation about the 'Artificiall Body' of society because 'such Truth, as opposeth no man's profit, nor pleasure is to all men welcome'.³⁷ It would seem from this that Hobbes regarded natural philosophy as a purely intellectual pursuit which was divorced from all scheming for profit or pleasure. In view of the foregoing it would seem that Hobbes was not in the least bit disingenuous when he said this. Natural philosophy, therefore, seems to have played little or no part in Hobbes' religio-political ideology.

2. Hobbes and the problem of matter in motion.

Although Hobbes used his preoccupation with his political writings as an excuse for the long delay in producing his system of natural philosophy, there is ample evidence to suggest that internal difficulties presented further hindrances. The final version of De corpore did not appear in print until 1655 but there were evidently earlier versions of the work in existence over ten years before this. Brandt has pointed out that in his Ballistica of 1644 Mersenne refers to De motu, loco et tempore by Hobbes and indicates that Chapter 28 concerns itself with hardness as does Chapter 28 of De corpore.³⁸ Furthermore, Sir Charles Cavendish wrote to John Pell at the end of 1644 to say that Hobbes

was 'nowe putting in order' his philosophy. However, Cavendish was quick to add: 'I feare that will take a longe time'.³⁹ We do not know what made Cavendish say this but he clearly had privileged knowledge of the problems confronting Hobbes. When he read Hobbes' manuscript in the following year his suspicions were confirmed and he reported to Pell: 'I doubt it will be long ere Mr Hobbes publish anything; so far as I have read, I like very well; he proceeds every day somewhat but he has a great deal to do'.⁴⁰ Whatever the state of completion of this early version of De corpore in 1644 we now know that Hobbes had also found time to write his lengthy and detailed critique of White's De mundo sometime between 1642 and 1644. It can hardly be lack of time to write which caused Hobbes' delay in going to press. Like Cavendish, Hobbes no doubt felt there were various problems which he still had to resolve. Indeed, in a letter written in 1649 Hobbes admitted that the proofs of certain propositions were causing him great difficulties.⁴¹

We cannot state now with any certainty just what these difficulties were: it may well be that there were a number of detailed considerations which Hobbes was unhappy with. We can be fairly certain, however, that at least part of the trouble concerned the fundamental assumptions of the new philosophy. Between

the Little treatise of the 1630s and the De corpore Hobbes made major changes in his conceptions of both matter and motion, the two fundamentals of the new mechanical philosophy. These changes and the delay in publication of De corpore clearly testify to Hobbes' dissatisfaction with and diffidence about his fundamental principles.

His changing ideas about the nature of matter, involve the concept of extension and the nature of space. I have already indicated in Chapter 1 the difficulties presented by the concept of space to early modern thought and it is beyond the scope of this thesis to study Hobbes' views in detail,⁴² suffice it to say that while Hobbes believes in the possibility of void space in the early 1640s by 1655 he is adamant about its impossibility. Correspondingly, Hobbes' particulate concept of matter gives way to a more continuist outlook. For example, it will be remembered that Hobbes interpreted the medieval concept of species in a quasi-atomist way in his Little treatise.⁴³ By 1651, however, he dismisses the idea that 'the Cause of Sense' is 'an ubiquity of Species' as one of the 'absurdities' of natural philosophy.⁴⁴ The reason for Hobbes' change of mind becomes clear in De corpore when we read:

For as for those that say anything may be moved or produced by itself, by species, by its own power, by substantial forms, by incorporeal substances, by instinct, by anti-peristasis, by antipathy, sympathy, occult quality, and other empty words of schoolmen, their saying so is to no purpose.⁴⁵

The concept of species, Hobbes now recognised did not satisfy the demands of strict mechanism. It was tantamount to relying on self-activating or active matter. There can be little doubt that Hobbes arrived at his new position under the influence of the strictly mechanistic Descartes, and by way of reaction against the Roman Catholic philosophies of the 'schoolmen' and probably the Blackloists.⁴⁶

It followed from his rejection of corpuscular species that Hobbes was in need of a new theory of light.

Having dropped the idea of innumerable light particles spreading out from the source, he turned to a mediumistic explanation in which light was propagated as a series of shocks through a continuous medium. The details of this have been superbly expounded by Brandt and we need not dwell on them here.⁴⁷ Essentially it depends on the new concept that a body is said to be luminous when it manifests an alternate expansion and contraction which sends pulses through the surrounding medium.

As Brandt points out, Hobbes could see a number of advantages in this conception compared to the emanationist view. He now has a clear means of explaining why light is propagated equally in all directions, and why it gets weaker with increased distance from the source.⁴⁸

More importantly, Hobbes can now (so he believes) drop his earlier insistence that light travels at finite speed and reconcile the concept of local motion with instantaneous propagation. Finally, his new theory

is not open to the objection that luminous bodies or any body which emits species will gradually be consumed. The early immaterialist tradition of light metaphysics taught that a light source could emanate its effects without diminishing itself. Hobbes' translation of this emanationist concept into material terms immediately raised the objection that the material of the source must eventually be totally dispersed.⁴⁹

Hobbes stuck to his second theory of light throughout the 1640s. He employed it in his critique of White, and in his three short optical treatises.⁵⁰ Furthermore, in the preface to his Ballistica, Mersenne described this new version of Hobbes' light theory and even explained how Hobbes used the expansion and contraction of the luminous Sun as a cause of the Earth's motion.⁵¹ According to Brandt, Mersenne took his information about Hobbes' theory of light and its role in cosmology from the early draft version of the De corpore.⁵² However, by the time De corpore appeared in print this theory of light has completely disappeared, to be replaced by yet another theory.

Brandt expresses his 'great astonishment'⁵³ at this late change in Hobbes' theory but makes no attempt to account for it. From the perspective presented here, however, the reason is perfectly clear. Hobbes' need for a new theory is thoroughly comprehensible if we

accept my contention that one of the over-riding concerns of the avant-garde theorists of the mechanical philosophy was to explain why matter is in motion and what keeps it in motion. The earliest answer to these problems, as we have seen, was to rely on the traditional notion of a self-moving, autodiffusive principle, light. This was Hobbes' own solution in the Little treatise. It also explains why theories of optics play such a large and important role in the early development of the mechanical philosophy and also adds another dimension to Brandt's astute judgement that the Little treatise was 'Hobbes' most important work on natural philosophy'.⁵⁴

However, Hobbes quickly began to see these ideas as 'vain philosophy',⁵⁵ which was lamentably occult in comparison with the more rigorously mechanistic Cartesian philosophy. Now, although Hobbes' new theory of luminosity rejected the notion of autodiffusive light and relied on a more mechanistic account with a number of advantages, it still had one major flaw. The perpetual contraction and expansion of a body like the Sun still remained to be explained.

In fact, Hobbes never did find an explanation for this perpetual pulsating motion and so he had to produce the third explanation which Brandt found so surprising. Before considering Hobbes' final version it is worth

pointing out that this second version was clearly inspired by William Harvey's work on the motion of the heart.

Hobbes describes the pulsation of the Sun in terms of systole and diastole, a clear sign that he is thinking of an analogy with the heart.⁵⁶ Hobbes was, therefore, inverting Harvey's own analogy in De motu cordis between the sun and the heart, 'the Sun of the Microcosm'.⁵⁷

Hobbes' second theory of light, then, was not significantly better than his first version. Ultimately he was still relying on a concept of self-active matter, even if this matter was all confined to the Sun (and presumably other stars).⁵⁸ The major inspiration on this phase of Hobbes' development, William Harvey, was insistent upon the innate activity of the heart which had 'in it life, motion and sense'.⁵⁹ Indeed, even Hobbes' notion of the Sun as a pulsating body may have been taken directly from Harvey:

the Sun deserves to be called the heart of the world, by whose vertue and pulsation, the blood is mov'd, perfected, made animate.⁶⁰

It would seem that Hobbes, for a while at least, tried to take Harvey literally.

Hobbes clung to his pulsific theory of luminosity for a number of years but he evidently abandoned it sometime before 1655. His final, published theory of light once again relied upon the perpetual motion of luminous bodies but this time the motion was explained in a way which Hobbes believed to be both strictly mechanical and

of a high pedigree. The key to this new explanatory system was Hobbes' concept of 'simple circular motion'. Frithiof Brandt has pointed out that Hobbes merely describes this unique concept in geometrical terms with hardly any attempt to explain it mechanically.⁶¹ Nevertheless, we can reconstruct Hobbes' explanation quite easily because, as Brandt convincingly shows, Hobbes is drawing upon Galileo's doctrine of circular inertia.⁶²

There can be no doubt that Hobbes admired Galileo more than any other thinker and it is almost certain that his belief in a fundamental circular motion comes from Galileo's physics. As Brandt says: 'it is to Hobbes as to Galileo a fundamental principle that 'by nature' there exist revolving motions'.⁶³ Because of his own previous immersion in the study of Galileo, Hobbes seems to assume that no further explanation of the 'mechanical' reality of these simple circular motions is necessary.⁶⁴ Once the motion has been initiated it will continue, all Hobbes need do is describe the geometry of this motion and the geometrical rules for the transmission of this motion to other bodies.⁶⁵

Before considering Hobbes' latest theory in more detail let us recapitulate the stages in the development of

his natural philosophy. In his efforts to describe all physical phenomena in terms of matter and motion Hobbes first of all relies upon the notion of self-active particles of matter flowing ceaselessly from gross bodies. Essentially Hobbes is operating here within the tradition of light metaphysics, inspired largely by the work of Robert Grosseteste, Roger Bacon and Walter Warner. Various considerations lead Hobbes to abandon his allegiance to this venerable tradition and to adopt instead the vitalist tradition which was contemporaneously being forcefully promulgated by William Harvey.⁶⁶ During this phase of his career Hobbes regarded the pulsific motion of his 'animated' Sun as the ultimate source of all other motions in the universe.⁶⁷ Finally, as a result of his rivalry with Descartes and his determination to match his strict mechanical philosophy, Hobbes abandons all trace of self-active movements and regards the motion of the Sun to be merely an inertial motion initiated by God at the Creation and subsequently causing motion throughout the world by transference and transmission. What, then, is the nature of this 'simple circular motion' displayed by the Sun?

The simple circular motion, initiated by God and continuing in accordance with the principle of circular inertia discovered by Galileo, consists of a gyration

in a small circle about a particular point. The clearest analogy of this motion (which is also made to carry some explanatory function) which Hobbes provides is that seen in the characteristic motion of a sieve in operation. According to Hobbes:

This as it is the most simple, so it is the most frequent of all circular motions; being the same which is used by all men when they turn anything round with their arms, as they do in grinding or sifting.⁶⁸

The Sun's light, as in the pulsation theory, is transmitted through the ambient medium but not simultaneously on all sides. (See figs. 4 and 5). The shock wave of light, as it were, is transmitted all around in the different directions successively, as the Sun's rapid gyratory motion takes it first one way and then another. By the same means the whole of the surrounding 'air' is stirred by the Sun's motion and given its own 'seething' motion.⁶⁹ This motion or 'fermentation' of the air can now be used to account for various other phenomena including not only obvious corollaries such as winds, but also heat, cold and even hardness and softness.⁷⁰ Hardness, for example, can be caused by a rapid simple circular motion of the small particles of the body, so that 'greater and less degree of hardness depends upon the quantity and velocity of those small bodies, and upon the narrowness of the place both together'.⁷¹ It is interesting to

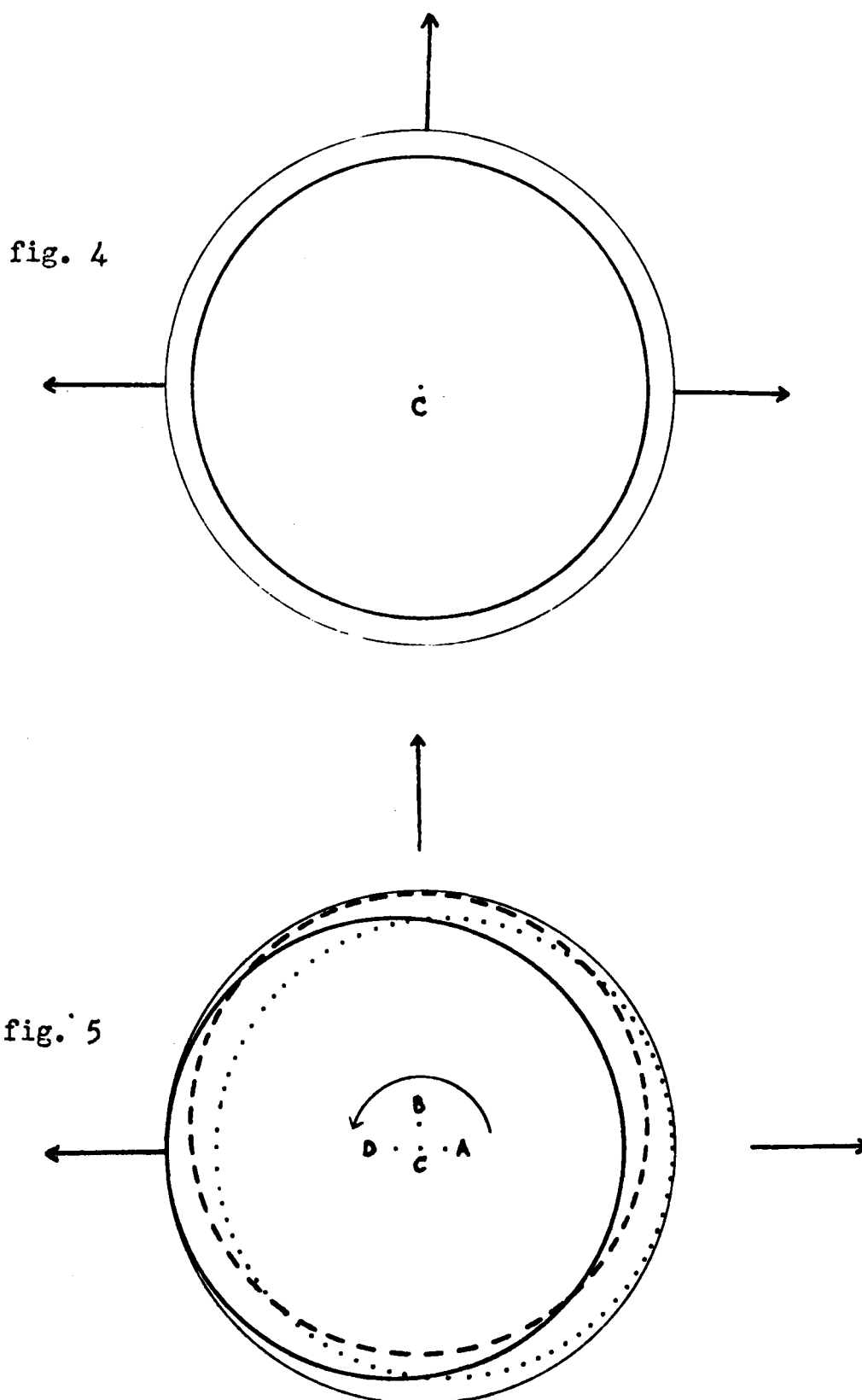


Fig. 4 shows the Sun dilating and contracting about a fixed centre, C, and so generating pulses of light (shown as arrows) simultaneously on all sides.

Fig. 5 shows the Sun in three successive positions as its centre moves in a small circle around the point C. The points A, B and D show the successive positions of the centre of the Sun as it moves. Pulses of light are given off in a correspondingly successive fashion and not simultaneously on all sides. The gyration of the Sun is so rapid that the staccato nature of the light pulses is indiscernible.

note that Hobbes has used here a hypothesis that he had evidently arrived at by 1648, since Cavendish wrote to Pell in that year and told of a dispute about hardness between Hobbes and Descartes:

Mr Hobbes conceiving the cause of it to be an extream quick motion of the atomes or minute partes of a bodie which hinders an other bodie from entering and Mr de Cartes conceived it a close joining of the partes at rest, which appears to me more reasonable.⁷²

Cavendish's scepticism about Hobbes' explanation may help to explain Cavendish's earlier suspicions that Hobbes had a long way to go before perfecting his system. Whatever Cavendish may have thought, however, Hobbes' theory of hardness can be seen as an excellent example of what Brandt sees as Hobbes' doctrine 'by which even the static is made kinetic'.⁷³ This in turn shows how deeply Hobbes was committed to the rubric of the mechanical philosophy; to explain all things in terms of matter in motion.

It is not necessary to go any further into the details of Hobbes' system. As Brandt says, behind all of Hobbes' physical hypotheses 'the simple circular motion in the full world occupies the principal place'.⁷⁴ And the reason for this is that it is regarded by Hobbes as his guarantee of a motive principle: circular motion will continue indefinitely,

as he believed Galileo had convincingly shown.

Unfortunately for Hobbes not everyone was quite so steeped in Galilean mechanics as he. By the time Hobbes published his system the concept of circular inertia had long been superseded by the concept of rectilinear inertia. Indeed, Hobbes himself refers to rectilinear inertia in De corpore but, as Brandt was dismayed to realise, it is clear that Hobbes had no real conception of its importance, and fails to notice its incompatibility with circular inertia.⁷⁵

As a result, the strictness of Hobbes' mechanistic system went unrecognised. In fact Hobbes' system was dismissed because he was believed to have held 'this regular motion of each atom' - the simple circular motion - to be 'naturae suae congenitus'.⁷⁶

Robert Boyle's refutation of Hobbes' concept of simple circular motion is especially interesting because it reveals how much other contemporary philosophers had to rely upon innate motions in their matter. Assuming, as Boyle did, that the motion of Hobbes' particles was innate then Hobbes' system has no advantage over that of the Gassendists. So, if we accept Hobbes' innate motions then we must ask:

whether or no Gassendus, and those other Atomists that admit creation, may not hence countenance their grand supposition of the congenite motion

of atoms, which granted, would destroy the best part of Mr Hobbes' philosophy.⁷⁷

Boyle himself, at this time, was struggling to explain the 'spring' of the air and, as we shall see, his most favoured explanation seemed to rely on inherent motion.⁷⁸ Once again, therefore, Boyle is able to point out that if Hobbes can assume inherent motions of particles so can he:

Those likewise, that fancy a spring properly so called in particular aerial corpuscles, will hence perhaps take occasion to think they may suppose an ingenite motion fit for their turn, as well as he an ingenite motus circularis simplex But whatever becomes of this motus circularis simplex, I need not be much sollicitous, having formerly shewn, that the admission of it would not disprove what I have delivered concerning the spring of the air.⁷⁹

The fact that Boyle has failed to realise the strictly mechanical nature of Hobbes' system is brought out in the comparison of Hobbes with Descartes:

the Cartesians will think it at least as allowable for them to suppose the motion he will not grant in their materia subtilis, as for Mr Hobbes to assume it in his particulae terreae; especially since he seems to make each such atom put into and kept in a regular motion; whereas they assume but the having of one general impulse given to the whole mass of matter How well likewise his hypothesis will agree with his fundamental doctrine, that Nihil movetur nisi a corpore contiguo & motu: 'Nothing is moved but by a contiguous body that is in motion': I leave him to consider.⁸⁰

A closer reading of De corpore would have revealed to Boyle that, like the Cartesians, Hobbes only invoked

God to give one initial impetus to the central body of the world; from then on the simple circular motions of all other bodies were established fully in accordance with Hobbes' law of motion.⁸¹

It is important to note that Boyle's rejection of Hobbes' philosophy does not stem from the fact that Hobbes relies on the inherent motions of matter. Boyle merely points out that this gives Hobbes' system no advantage over alternative systems. Furthermore, as the particular kind of inherent motion which Hobbes attributes to matter seems implausible on a number of grounds and there is no 'unquestionable example or experiment' which reveals such motions,⁸² Boyle concludes that Hobbes' system carried too many disadvantages compared to alternative systems.

The real reason behind Boyle's rejection is Hobbes' unfortunate reputation as an atheist. Ironically, Hobbes' atheism is such an idée fixe with Boyle that he dismisses Hobbes' invocations of God in the De corpore as disingenuous:

for philosophers that are known to wish very well to religion, and to have done it good service, have been very shy of having recourse, as he has, to creation, for the explaining of particular phenomena.⁸³

Boyle makes the major reason for his refutation of Hobbes perfectly explicit in the Preface to his Examen of Mr T. Hobbes:

It was also suggested to me, that the dangerous opinions about some important, if not fundamental, articles of religion, I had met with in his Leviathan, and some other of his writings, having made but too great impressions upon divers persons (who, though said to be for the most part either of greater quality, or of greater wit than learning, do yet divers of them deserve better principles) these errors being chiefly recommended by the opinion they had of Mr Hobbes' demonstrative way of philosophy;⁸⁴ it might possibly prove some service to higher truths than those in controversy between him and me, to shew, that in the Physics themselves, his opinions, and even his ratiocinations, have no such great advantage over these, of some orthodox Christian Naturalists.⁸⁵

We have already seen that Hobbes' reputation for atheism was (and to a large extent remains) based upon misconceptions of his arguments.⁸⁶ And we have now observed that Boyle's rejection of his principle of motion was also somewhat misconceived. Whatever the justice or injustice of these matters, the fact remains that Hobbes' natural philosophy - the only determined effort to construct a mechanical philosophy equivalent in its strictness to that of Descartes⁸⁷ - was a failure.

3. Hobbes, Descartes and the early development of the mechanical philosophy.

I said at the beginning of this chapter that Hobbes developed his mechanical philosophy not only under the shadow of Thomas White, during his detailed refutation of the priest's De mundo, but also as a reaction to many aspects of Descartes' philosophy. Indeed, it is

quite obvious that Hobbes saw Descartes (rather than White) as his main rival and these feelings were to a large extent reciprocated. Here again, Brandt has uncovered the biographical background to the rancour between the two men and has considered most of the technical disputes about points of detail which were used in their battles.⁸⁸ In this section I wish to supplement Brandt's comparison between these two leading exponents of mechanical philosophy by bringing to light a number of important features which have not been noticed, either by Brandt or anyone else.

We have shown that there is a clear progression in Hobbes' natural philosophy from an atomistic system heavily dependent on self-moved particles of light, which are ultimately derived from the tradition of light metaphysics, to a more rigorous mechanistic philosophy in which self-movers have been replaced by a concept of passive matter having inertial motions continuing indefinitely after initiation by God. There is ample evidence to suggest that Descartes' own philosophy, in spite of appearances, developed in a strikingly parallel way.

The most immediately obvious suggestion of the metaphysical importance of light in Descartes' system is provided by

the sub-title of his first work on natural philosophy.

Le monde bears the alternative title: Traité de la lumière. Descartes himself frequently referred to Le monde simply as the treatise 'on light'. Consider, for example, his clear statement in a letter to Father Vatier (February 22, 1638):

'le traité qui contient tout le cors [sic: corps?] de ma Physique porte le nom de la Lumière'.⁸⁹

Descartes' explanation of light in terms of mechanical principles was the starting point for his whole unified mechanical system of nature. The most recent and most detailed study of Descartes' natural philosophy refers to Le monde as Descartes' 'light cosmology' and argues that 'in Le monde the micro-mechanical theory of light became the conceptual kernel from which sprang a mechanical philosophy of nature conceived on a cosmic scale, and the principles which lay behind his theory of light emerged there with the status of "laws of nature"'.⁹⁰

However, it is easy to see that already in Le monde, Descartes' explanation of light is entirely mechanistic, rather like Hobbes' explanation in De corpore. There is no conception of light as formed of self-moving corpuscular species which we have taken to be characteristic of the seventeenth-century version of light metaphysics. Even Descartes' earliest explanations

of light explain it in terms of a pressure wave through the medium of his aether.⁹¹ It would seem that, among the earliest exponents of a mechanical philosophy, Warner, Hobbes, Digby, White and Descartes, only the Frenchman was advanced enough in his thinking to leap straight to a bona fide mechanist explanation without passing through an earlier stage dependent on light metaphysical principles. Drawing heavily upon the meticulous researches of John Schuster, however, I believe it is possible to indicate that Descartes' appearance in this regard is merely a twist of fate and that, in reality, whatever his own writings may suggest, Descartes did pass through an earlier phase of thought similar to that of Warner, Hobbes, and Digby.⁹²

According to Schuster, Descartes began his career in natural philosophy as a mathematician seeking to solve various problems in mechanics which had been bequeathed by antiquity. At this point, therefore, Descartes was not a system builder but was part of the new tradition of philosophy dealing in a piecemeal way with various problems, rather like Galileo and Thomas Harriot.⁹³ His initiation to the mechanistic vision of the world was provided by the Dutchman, Isaac Beeckman (1588-1637). Beeckman was very much Descartes' mentor during his first stay in Holland from 1618 to 1620,

and Beeckman was one of the earliest thinkers to recognise the heuristic value of atomism for explaining various problems which proved difficult for Aristotelian philosophy. After a period of absence from Holland, Descartes re-established contact with Beeckman in the autumn of 1628. It is this second period of close contact between the two men that is crucial to our argument. We know that Descartes had access to Beeckman's Journal and the entries for that journal, between July 1628 and June 1629, reveal that Beeckman was absorbed in some extremely significant speculation.

The background to these speculations was a thorough examination of the works of Kepler and a desire to establish a restitutio astronomiae on which Beeckman could provide not simply a mathematical description of heavenly motions but a mechanical explanation of those motions.⁹⁴ In a series of different hypotheses proposed by Beeckman to account for the constancy of planetary distances from the sun, light plays an important heuristic rôle.

Beeckman's first effort along these lines is to explain 'why the moon does not fall to the earth':

Let the rays of the sun reflected from the earth have a power of attracting the moon, but let the earth itself have a power of repulsion ... so now I say that the rays of the sun reflected from the earth retain their power much further [diutius] than the rays of the earth itself; since they come there from a more remote place;

and for this reason: there is a scanty proportion between the distance from the sun to the earth and the earth to the moon and the distance merely from the sun to the earth. Therefore, the sun's rays have as much virtue near the moon where it is now, as it would if it were next to the earth. However, the earth has much more power near to itself than near the moon, where it now is, because there is a very great proportion between the distance from the earth to the moon, where it is now, and the distance from the earth to the moon should it be next to the summits of the [earth's] mountains. Therefore, the earth strongly repells the moon when it is near; but this force disappears gradually as it flows away from the earth. In this way the moon can neither recede further from the earth nor approach closer to it.⁹⁵

In a later entry Beeckman extends this idea to account for the steady orbital distances of all the planets (including the earth) from the sun. In this case he invokes light from the stars as well as sunlight in his explanation: 'the light or corporeal virtue of the eighth heaven reflected from the sun draws all the planets to it [the sun], but the sun repells from itself'.⁹⁶

Subsequently the Dutchman drops the notion of a power or virtue from the stars reflected by the sun and proposes instead that the sun has a magnetic attractive virtue. This attractive force, however, operates in opposition to a repulsive force brought about by the constant stream of particles of light and heat which are emitted by the sun.⁹⁷ This marks a significant advance in his argument. His first speculation

is clearly occult because he can give no satisfactory account of why reflected light attracts and direct illumination repells. Although this new hypothesis relies on the occult power of magnetism this can be defended up to a point on grounds of experience.⁹⁸

The repulsive power of emitted light and heat particles presents no problem at all as it is based firmly on a mechanical analogy, and is immediately comprehensible.

Beeckman quickly manages to improve his hypothesis even further by doing away with occult magnetism. He simply argues that the stars give off emanations which push the planets to the centre while the pressure of light and heat given-off by the sun pushes them out from the centre.⁹⁹ Already, it is easy to see that there are a number of parallels here between Beeckman's speculations and those we have seen in Warner's papers, Hobbes' Little treatise and Digby's Treatise on body.¹⁰⁰

Beeckman even gives an atomistic interpretation of species in the same way as Hobbes: 'the species of things are corporeal fluxions from things', and 'what the optical theorists (Optici) call visible species are bodies'.¹⁰¹

Perhaps the most significant congruence for the development of the mechanical philosophy is to be found between Beeckman's Journal and Warner's papers.

At the beginning of Beeckman's contemplation of Kepler's Astronomia nova,¹⁰² written in the autumn of 1628, he declared:

I will discuss (again) these things more accurately than him [Kepler], on account of the principle mentioned in the previous section, which he did not wish to know, namely that light et cetera are corporeal, but also because he did not know what is very true: all things, once moved, always move unless they are impeded.¹⁰³

Writing at roughly the same time (certainly before 1630)

Warner, in his discussion of causation, insisted:

If a thing be set in motion or in any state and afterwards left by the cause, that motion or state whatsoever is it self a sufficient cause of his own continuance till it be resisted hindred or altered by some contrary ...

And again:

In the alteration from quiet to motion it is manifest ... that the state of the patient being, by supposition, motion during the application, it doth keep and continue the state of motion, without interruption after the recesse of the agent, eternally unless it be hindred or stopped by a contrary force and look in what degree of velocity it was at the very instant of the separation of the agent, in that state of the same velocity it doth continue till the next encounter.¹⁰⁴

These early statements of the principle of inertia are obviously intimately bound up with the early development of the mechanical philosophy and it is significant that both men mention it in close connection with the active power of light.¹⁰⁵

It would seem, therefore, that just as Hobbes received inspiration from Walter Warner and his theories, so Descartes was inspired and influenced by the speculations of Isaac Beeckman. Certainly, John Schuster, after a

thorough absorption in the writings of both Descartes and Beeckman expresses his own conviction that Descartes was influenced by these Journal entries.¹⁰⁶ The only real distinction between Hobbes and Descartes is that Hobbes set down on paper a naive, not fully mechanistic account of philosophical principles in his Little treatise, while Descartes, as far as we know, was quick witted enough to leap-frog beyond this stage. If we bear in mind this, admittedly important, distinction the essential parallelism can be stated as follows. On the one hand Walter Warner develops a natural philosophy which relies for its explanatory power on the motion of light, Hobbes, recognising that the motion of the light itself is ultimately unexplained, gradually develops a more rigorous mechanistic account. While on the other hand Isaac Beeckman develops a natural philosophy which relies for its heuristic on the motion of light particles; Descartes, realising that the motion of light itself needs to be explained, quickly develops a more rigorous mechanistic account.¹⁰⁷

The parallels do not end there. Just as Hobbes was accused of plagiarising from Warner's papers so Descartes was accused of plagiarising Beeckman's Journal. These accusations came from Beeckman himself and they do serve to show that Descartes must have had the opportunity

to study the Journal closely.¹⁰⁸ In view of Beeckman's comparative obscurity today one is inclined to sympathise with the strength of Beeckman's feeling on this matter. Nevertheless, it must be admitted that Descartes has gone far beyond Beeckman in his natural philosophical synthesis. Descartes, like Hobbes, must have seen (and seen more quickly than Hobbes) the problems confronting the materialist version of light metaphysics: why was the sun not exhausted? did light travel with infinite speed? and so on.¹⁰⁹

It was Descartes' development of the concept of conatus (inclination or endeavour) which enabled him to solve these problems and account for light in terms of a shock instantaneously transmitted through the plenum. Here again there is an undeniable similarity between the theories of Descartes and Hobbes. In this case, however, it is certainly Descartes who has the more rigorous and self-consistent conception of what exactly conatus is and what is its rôle.

Briefly, Descartes adheres to the notion of rectilinear inertia. The fact that the matter in the universe moves circularly is merely a consequence of the fullness of the universe and the need for a continuous circular displacement to allow any movement at all.¹¹⁰

Because of the crush of ambient matter there is always, in effect, a net force on the matter in a vortex towards the centre, analogous to the tension in a sling when a stone is whirled around before being thrown. Any given particle of matter in the vortex, however, has a tendency to move tangentially. According to Descartes only part of this tangential tendency is counter-acted by the force toward the centre (otherwise the body would move towards the centre) while another component of the tangential tendency manifests itself centrifugally, radially outwards from the centre. It is this conatus, this centrifugal tendency which causes the sensation of light in sentient beings and the other phenomena associated with light. There is, therefore, no actual transmission of a physical object merely a transmission of action, a slight pressure, through the medium.¹¹¹

The conception of conatus as it is used by Descartes, then, is an integral and indispensable part of his mechanical philosophy. Furthermore, as Schuster points out, it clearly derives from the mathematical device of the parallelogram of forces, and so provides a way for Descartes to apply the mathematical analyses of statics to kinetic problems.¹¹² Similarly, Frithiof Brandt insists that 'only by means of the conatus concept does Hobbes succeed in fully applying his doctrine of motion by which even the static is

made kinetic'.¹¹³ However, it should not go unnoticed that Hobbes, unlike Descartes, does not need the concept of conatus to account for light. As we have seen, Hobbes explained light pressure through the medium by envisaging a pulsating light source or, later, a gyratory light source pushing first one way, then another successively in a circle.¹¹⁴ If we bear this in mind it makes Hobbes' adaption of the principle of conatus a rather more ad hoc affair than it is for Descartes.

The ad hoc nature of conatus in Hobbes' philosophy seems to be verified even by the nature of its first appearance in De corpore. It only appears in Part III and is introduced at the end of a recapitulation of eleven principles of motion which have been mentioned earlier in the work. Furthermore it is introduced out of the blue, so to speak, and simply defined rather than developed as the result of an argument, as is the case with Descartes' conatus.¹¹⁵ Moreover, as Brandt recognises, the earliest use of conatus by Hobbes was as an analogy between appetite and impulse in motion. In chapter 7 of the Elements of Law, for example, Hobbes declares:

This motion, in which consisteth pleasure or pain, is also a solicitation or provocation either to draw near to the thing that pleaseth,

or to retire from the thing that displeaseth.
 And this solicitation is the endeavour or internal
 beginning of animal motion, which when the object
 delighteth, is called APPETITE; when it displeaseth,
 it is called AVERSION¹¹⁶

Hobbes, even in his later, more rigorously mechanistic
 phase never manages to fully dissociate his concept of
conatus from these animistic beginnings. This is
 underscored later in De corpore when a discussion of
conatus leads Hobbes into saying: 'To what has been
 said of motion, I will add what I have to say concerning
 habit'. In spite of careful definitions to the effect
 that 'Habit ... is a generation of motion, not of
 motion simply, but an easy conducting of the moved
 body in a certain and designed way',¹¹⁷ the reader
 is left in little doubt that Hobbes' mechanism is
 tainted here by animism.

It rather seems to this interpreter, then, that Hobbes'
 use of the concept of conatus was adopted in large
 measure from the work of Descartes. While Hobbes
 was perfectly capable of recognising its usefulness
 for explaining some static phenomena in kinetic terms
 (such as weight¹¹⁸) he never recognised just how
 intimately and how elegantly it was bound up with
 what Schuster calls Descartes' 'light cosmology'.
 Had he done so he might have embraced it more whole-
 heartedly and abandoned his own cumbersome device:

the gyrations of the 'simple circular motion'.

If Hobbes' inadequate understanding of the concept of conatus must count against him in any comparison with Descartes, there is one aspect of Hobbes' system which must be counted as an advantage over the Cartesian system. Descartes theory of planetary motions, as E.J. Aiton has shown, took no account of Kepler's astronomical work. By contrast, Hobbes managed to provide a mechanistic account in support of Kepler's elliptical orbits. It is worth considering Hobbes' argumentation here because, as far as I know, nobody has commented upon it before. Furthermore it provides an excellent example of Hobbes' method as it was applied to one of the major considerations for the new philosophy: how to account for planetary motions. Before examining Hobbes' argument we should remind ourselves of the Cartesian position.

There are a number of places in the Principles and elsewhere in which Descartes points out that 'les mouvements des Cieux ne sont pas parfaitement circulaires'.¹¹⁹ There are even one or two places where he refers to the orbit of the Moon as having the form of an ellipse.¹²⁰ However, these comments cannot be taken to be an attempt to accommodate Kepler's first law of planetary

motion within the Cartesian system. This can be seen by considering a letter which Descartes wrote in 1648 or 1649 to an anonymous correspondent. Here Descartes explains that:

I have not described in my Principles all the motions of each planet, but I have supposed in general all those that the observers have found and I have attempted to explain the causes ...¹²¹

The motions that 'observers have found' which lead him to suppose that the planets do not move in perfect circles show no knowledge of Kepler's astronomy. The planets, Descartes points out:

deviate irregularly from the regular circle that one imagines they should describe ... so that divers Apogees or Aphelions, and Perihelions or Perigees have been attributed to them¹²²

The designation 'elliptical' is only applied to the Moon's orbit and yet any suggestion of Keplerian influence is belied by the fact that the Earth is said to occupy the centre of the orbit. It would seem that Aiton's judgement is correct: there is no evidence that Descartes even knew of Kepler's law.¹²³

We now turn to Hobbes.

No sooner does Hobbes introduce his concept of simple circular motion than he goes on to insist that 'such things as are moved with simple circular motion, beget simple circular motion'.¹²⁴ This transmission of the simple motion only occurs, of course, through a material medium. Hobbes follows up this geometrical

proof with a rather more interesting one. He introduces it like this:

If in a fluid medium, whose parts are stirred by a body moved with simple [circular] motion, there float another body, which hath superficies either wholly hard, or wholly fluid, the parts of this body shall approach the centre equally on all sides; that is to say, the motion of the body shall be circular, and concentric with the motion of the movent. But if it have one side hard and the other fluid, then both those motions shall not have the same centre, nor shall the floating body be moved in the circumference of a perfect circle.¹²⁵

Hobbes demonstrates this by supposing a spherical body consisting of a solid hemisphere and a (fairly tenacious or viscous) fluid hemisphere which is separated from a solid sphere by a fluid medium. Now as the solid body moves with a simple circular motion the surrounding medium will pick up this motion and begin to 'seethe' so that all its parts 'do continually change their places'.¹²⁶ Now, if we consider the heterogenous body to have its liquid hemisphere turned towards the rotating body then the small parts of the liquid at the surface must 'enter into the places of the small parts of the medium which are contiguous to them' (on the principle of fuga vacui). Because the liquid is tenacious, however, it will not break up but will bulge out to fill the spaces in the medium without undergoing any gross change of place. If the solid hemisphere is turned towards the rotating body, however,

then:

By reason ... of the said change of place of the parts [of the medium] which are contiguous to it, the hard superficies must, of necessity, seeing by supposition there is no empty space, either come nearer to A [the central body], or else its smallest parts must supply the contiguous places of the medium, which otherwise could be empty. But this cannot be, by reason of the supposed hardness; and therefore the other must needs be, namely, that the body come nearer to A [the centre].¹²⁷

It only remains for Hobbes to point out that any such body rotating around another will not always keep one side to the central body and so 'it is sometimes near, sometimes further off from the centre' and is not, therefore, carried in a perfect circle.

Later Hobbes seeks to explain 'the eccentricity of the annual motion of the earth':

When the earth is in the beginning of Capricorn ..., the sun appears in the beginning of Cancer ...; and then is the midst of summer. But in the midst of summer, the northern parts of the earth are towards the sun, which is almost all dry land, containing all Europe and much the greatest part of Asia and America. But when the Earth is in the beginning of Cancer ..., she is in the midst of winter, and that part of the earth is towards the sun, which contains those great seas called the South Sea and the Indian Sea which are of far greater extent than all the dry land in that hemisphere. Wherefore by the last article ... when the earth is in [Cancer], it will come nearer to its first movement, that is to the sun ... that is to say, the earth is nearer to the sun in the midst of winter ... than in the midst of summer.¹²⁸

Hobbes makes it perfectly explicit that he is in agreement

with Kepler on this matter and claims to have explained why the motion of the Earth is not a perfect circle 'but either an elliptical, or almost an elliptical line'.¹²⁹ Nevertheless, this argument, ingenious though it was, was insufficient to win converts to Hobbes' system. As we said at the end of the previous section, as far as Hobbes' contemporaries were concerned, his system was a failure.

So far we have been considering what may be called the 'home-grown' versions of the new philosophy in seventeenth-century England. While these efforts are extremely important in their own right it has to be admitted that they failed to win over large numbers of philosophical converts. Warner never satisfactorily completed his system and it remained largely unseen amongst his other papers.¹³⁰ Digby and White attracted some attention during the Interregnum but as Catholics, known to be engaged in various political efforts on behalf of recusants, their philosophy would be unlikely to win full acclaim even from readers unaware of its ideological intentions. Ironically, although Hobbes' philosophy was innocent of any extra-scientific designs it was not regarded that way. Hobbes' materialism was seen as an elaborate argument for atheism and was therefore

even more insidious than Blackloism.¹³¹ Even so, the new philosophy did spread and the effort to explain all phenomena in terms of matter and motion became the new orthodoxy in natural philosophy. The major influence, therefore, must have come from the Continent where Descartes and Gassendi were engaged on expounding different versions of this new philosophy. We turn now to see how each of these were popularised in England.

CHAPTER 5

THE ESTABLISHMENT OF THE MECHANICAL PHILOSOPHY:

HENRY MORE AND WALTER CHARLETON

In this chapter I hope to show that the two single most important thinkers responsible for the popularisation of the mechanical philosophy in its early stages in England were Henry More (1614-1687) and Walter Charleton (1619-1707). The former was one of the earliest and one of the most forceful advocates on behalf of Descartes (1596-1650) while the latter was the leading English proselyte of Pierre Gassendi (1592-1655). Neither More nor Charleton are remembered today as leading contributors to the progress of science¹ and there can be little doubt that they both regarded the mechanical philosophy as a crucial means of settling the religious disputes of mid-century England. Accordingly, the first section of the chapter will consider this aspect of their natural philosophical endeavours.

More's espousal of Cartesianism in order to promote his own kind of liberal Anglicanism has attracted much scholarly attention and is now well-known.² However, the full extent of the Cartesian influence upon More's concept of the soul and his eschatological beliefs has never been recognised. By providing a brief survey

of these matters here I hope to supplement the work of earlier scholars in this field and also to provide evidence, further to that presented in Chapter 3, of the close links between the mechanical philosophy and seventeenth-century eschatological concerns.

The ideological intentions underlying Charleton's work is not so well-known and I will try to establish them in a brief survey of his early writings. I will then try to show that Charleton's approach to the ideological use of natural philosophy was more likely to have been influential upon his contemporaries than the approach of Henry More, which was liable to seem dangerously counter-productive. My argument will, I hope, provide extra force to the conclusion of Richard Popkin, Henry van Leeuwen and others that one of the most important responses to the 'crisis of European thought',³ was the development of the position of 'mitigated scepticism'.⁴ A cautious incredulity was regarded by the orthodox intelligentsia as the only safe response to the dogmatism of Roman Catholics and fanatical or 'enthusiastic' Protestant sects. All dogmatic positions in intellectual debates were thought to be open to distortion and abuse by these subversive elements in English society and thus became discredited in the eyes of the orthodoxy. The mitigated sceptical approach was developed primarily by Mersenne and Gassendi, as

Popkin has shown,⁵ and was first applied in English natural philosophy, I contend, by Walter Charleton. Henry More, by contrast, was as dogmatic as any 'enthusiast' in his early philosophical writings and only realised the dangers of this approach in the early years of the Restoration era. Ultimately, it was Charleton's probabilist philosophy of science which held sway in late seventeenth-century England.⁶

Sections 2 and 3 deal respectively with More's and Charleton's responses to the problem of activity in matter theory. My task here is straightforward since each man is perfectly explicit about his reliance on an active principle. More's superimposition of a 'hylarchic' principle onto Cartesian mechanics has been closely studied by historians and much of it needs no repeating.⁷ I will merely point out one or two unnoticed aspects of More's 'spirit of nature' to underscore the main thrust of my thesis. In particular I hope to show that More was influenced to some extent by light metaphysical traditions. Furthermore, I believe there are indications that More's adaptations to the Cartesian system did not simply stem from his religious concerns but that he, no less than other mechanical philosophers in England, recognised inadequacies in the natural philosophy of Descartes.

In Charleton's case I will simply point out his belief

in active matter. We do not have to search far for the evidence for this. Nevertheless, it is not something that it is well-known about Charleton or about Gassendist philosophy in general. It is important for us to spend some time, therefore, in establishing what Robert Boyle calls the Gassendists' 'grand supposition of the congenite motion of atoms'.⁸

1. Henry More, Walter Charleton and the Anglican origins of modern science.

Both Henry More and Walter Charleton turned to the mechanical philosophy in their published writings as a means of settling the religious disputes of mid-century England.⁹ They can be seen, therefore, as following the precedent established in England by Digby and White. Like them, More and Charleton firmly believed that natural philosophy could be invoked to establish or to bolster religious doctrines and to convert atheists and heretics to the true faith. Furthermore, their separate enterprises were more likely to succeed than that of the Blackloists because they were Protestant and not Catholic. Even so, it should be remarked, their task was not an easy one since they were both arguing for Anglicanism at a time when the Church of England was proscribed by the rebel government. In spite of these similarities there are very important differences between the two men. They were working almost entirely independently

of one another. More was devoted to Cartesianism while Charleton, who spent some time in Paris as a member of Mersenne's circle, entered the lists as a champion for Gassendi. As a result they each played the predominant role in popularising their respective mentor's work in England.

Perhaps the most obvious example of More's influence is the fact that Cartesianism made much greater headway in Cambridge than it did in Oxford.¹⁰ One of More's disciples, Joseph Glanvill (1636-1680) lamented that his friends did not first send him to Cambridge, because ... that new philosophy and art of philosophizing were there more than here in Oxon'.¹¹ While another disciple, John Hall, a fellow of St. John's went so far as to suggest reform of the Universities to bring them in line with Cartesian principles.¹² Alongside More's pedagogical influence was the influence of his writings. Between 1648 when More first became acquainted with Descartes' writings (and, indeed, Descartes himself), and 1662 when he wrote an extensive defense of Cartesianism to his correspondent known only as 'V.C.', there can be no doubting More's admiration for Descartes.¹³ In a letter to Samuel Hartlib (d. 1670?) in 1648 More insisted that 'all that have attempted anything in naturall Philosophy hitherto are mere shrimps and fumlbers in comparison of him' and that Descartes was 'the very Miracle of the world'.¹⁴

Walter Charleton, on the other hand, reserves most of his praise for Gassendi. In the 'Preparatory Advertisement to the Reader' which prefaces The Darknes of Atheism¹⁵ he admits to being under the influence of Descartes and others but 'chiefly of Gassendus (in Animadvers. in phys. Epicuri.) the leaves of whose most learned Works, we blush not to confesse our selves to have been so conversant in, that we have sullied them by often revolution'.¹⁶ Charleton's most important contribution to the spread of Gassendism, however, was undoubtedly the fact that he provided a translation and close paraphrase in English of the natural philosophical part of Gassendi's Animadversiones as his Physiologia Epicuro-Gassendo-Charletoniana.¹⁷ Here again, thanks to the work of other scholars it has now been well established that Charleton's Physiologia was an important influence upon Robert Boyle and the young Isaac Newton.¹⁸

Henry More is entirely explicit about declaring the reasons for his interest in Descartes' philosophy. As a leading member of the so-called Cambridge Platonists he wholeheartedly endorses the Platonic emphasis on the unity of knowledge, whatever the source might be.¹⁹ Because he believed that 'no revelation is from God

that is repugnant to sense rightly circumstantiated',

More insisted:

I can ex animo avow to all the world that there is no real clashing at all betwixt any genuine point of Christianity and what true philosophy and right reason does determine or allow, but that ... there is a perpetual peace and agreement betwixt truth and truth ... and that they are blind superstitionists or superficial philophastrs that imagine any such digladiation betwixt true philosophy and real Christianity.²⁰

The Cartesian philosophy, then, was to play the role of confirming by 'right reason' the 'real Christianity' which was evident to More:

there is no other philosophy, unless one except the Platonic, which combats the atheists so strongly down to the foundations of their stronghold and which destroys their dwellings so happily as the Cartesian philosophy if properly understood.²¹

It was by means of the Cartesian philosophy that 'such as are intended to serve the Church will be armed betimes with sufficient strength to grapple with their proudest Deriders or Opposers'.²² And it is precisely for this reason that More's major philosophical works repeatedly expound upon or refer to the work of René Descartes.

In his Antidote against atheism,²³ for example, More endeavoured to prove the existence of God by three different kinds of argument. The first two of these were clearly derived from Descartes. In Book I he adapted Descartes ontological argument based on the idea of 'a Being absolutely perfect', which must

necessarily exist. Book II sought to establish God's existence by the argument from design using many of the designs of Descartes if not strictly those to be found actually in Nature. The third book was More's own contribution: being an examination of what would now be called 'paranormal' phenomena but which More referred to as 'supernatural'.²⁴ Similarly, in the 'Philosophick part of Conjectura cabbalistica, More attempted to show that the ancient Pythagorean philosophy which gave rise to Platonism was derived from the Jewish traditions of the Mosaical philosophy and, most importantly, it was tantamount to Cartesianism.²⁵ But perhaps the most significant work along these lines is More's examination of The immortality of the soul.²⁶

We have already seen how important the nature of the soul and its state after the death of the body were in seventeenth-century thought. Mortalism was an increasingly popular heresy, intimately bound up with the major differences between Catholic and Protestant, and which also seemed, for orthodox thinkers at least, to have implications of atheism.²⁷ When More wrote his treatise on the soul in 1659 Digby's attempt to use the new natural philosophy to settle disputes about the nature of the soul was well-known, and Hobbes had made his mortalism explicit in the hated Leviathan.²⁸ More's work was undoubtedly written

in response to these works as well as in response to the general threat of atheism which More recognised all around him.²⁹

The immortality of the soul consists of three books.

The first attempts to establish the existence of 'spiritual' or incorporeal entities and to define their nature and principal characteristics. At the end of the first book More declares:

we have demonstrated beyond all Evasion, from the Phaenomena of the Universe. That of necessity there must be such a thing in the world as Incorporeal Substance; let inconsiderable philosophasters hoot at it, and deride it as much as their Follies please.³⁰

The second book sets out to establish that the human soul is just such a 'Spirit or Immaterial Substance in Man', and proceeds to establish in some detail the nature of this Spirit and its relationship to the individual man. In the third and final book More turns to 'the state of the soul after Death'.³¹

The details of More's pneumatology, as far as I know, have not received close scrutiny even from historians of religion. It seems to me, however, that these aspects are of the utmost importance for understanding More's reaction to and use of the Cartesian philosophy. In particular I believe it will suggest that the current interpretation of More's 'Spirit of Nature' - his hylarchic principle - may well be somewhat misleading.³²

More's 'Spirit of Nature' is usually regarded as an incorporeal or immaterial entity which is basically inimical to the demands of the mechanical philosophy. More's insistence upon the necessity of this hylarchic principle is therefore regarded as a theological imposition upon the mechanical philosophy. I believe that the spirit of nature is, however, by no means as immaterial or incorporeal as we might suppose if we take More's talk of 'Incorporeal' and 'Immaterial Substance' at their face value. Indeed, it seems to me that the very notion of incorporeality is used in a highly paradoxical way by More. This is best brought out by a study of More's doctrines on the immortal soul.

It is now well-known, thanks to the work of Burt and Koyré, that More extended Descartes' category of res extensa to include spiritual entities, including souls (which Descartes placed in a separate category as res cogitans).³³ More's reason for doing this was his belief that if something exists it must exist in space.³⁴ Descartes belief that res cogitans do not occupy space was vigorously dismissed by More as 'nullibism'. More clearly believed that nullibism would lead inexorably to atheism.³⁵ It is usually assumed that More's reaction shows a failure to understand or, at best, an unconcern for, the details of Descartes' metaphysics.³⁶ However, I believe it is possible that More's position

has not been properly understood. If we assume that More believed the soul to be a natural member of the Cartesian category of res extensa because it was material and extended then his divergence from Cartesianism is by no means as great as has been supposed. We do not have to rely on assumption, however: there are clear indications of the materiality of souls in More's book on The immortality of the soul.³⁷

At the beginning of Book III More describes three states of the soul, or rather three substantial vehicles in which it always inheres. The soul must always be 'united vitally with some matter or other',³⁸ because, as Descartes has shown, 'the universe is everywhere thick-set with matter'.³⁹ This remains true even after the death of the body:

it is plain that the nature of the soul is such, as that she cannot act but in dependence on matter, and that her operations are some way or other always modified thereby. And therefore if the soul acts at all after death, (which we have demonstrated she does) it is evident that she is not released from all vital union with all kind of matter whatsoever ...⁴⁰

Upon release from the earthly body, therefore, the soul inheres either in an aërial or in an aethereal body. These three kinds of body are related to the three kinds of matter which form the basis of Descartes' matter theory.⁴¹ The aethereal vehicle of the soul,

for example, is identified with Descartes' first element, 'which is the most subtile and active Body that is in the World, and is of the very same nature that the Heaven and Stars are, that is to say, is the very Body of Light'.⁴² The aëreal body performs a number of useful functions. More seems to regard it as an easily acceptable half-way stage between the bodily soul and the 'disembodied' or aethereal soul so that nature need not admit 'of so great a Chasme'. It also provides a convenient means of explaining (and insisting upon the reality of) ghosts. The normal state of affairs after death is for the soul to leave its terrestrial vehicle in the aëreal mode which it may stay in for 'many ages', before aspiring to the aethereal state. As More says: 'there are very few that arrive to that high Happiness, as to acquire a Celestial Vehicle immediately upon their quitting the Terrestrial one'.⁴³

More believed that by this means he had opened the way for easily intelligible speculations about the nature of life after bodily death:

So that we need not bemoan the shrivell'd condition of the deceased, as if they were stript almost of all Substance corporeal, and were too thinly clad to enjoy themselves as to any Object of Sense. For they have no less body than we our selves have, only this Body is far more active than ours, being more spiritualized, that is to say, having greater degrees of Motion communicated unto it.⁴⁴

It would seem from this that More was as much infected by the increasing materialism⁴⁵ of his age as any one. While men like Donne, Overton, Milton and other mortalists could only envisage a life after death in terms of a bodily resurrection, More could rely on a spiritualized but nonetheless bodily future life:

It is manifest that the Soul ... loseth nothing by Death, but is a very considerable gainer thereby. For she does not only possess as much Body as before, with as full and solid dimensions, but has that accession cast in, of having this Body more invigorated with Life and Motion then it was formerly.⁴⁶

However, this does not mean that More was a crypto-mortalist. On the contrary he developed his ideas, as did Digby and White,⁴⁷ in order to refute mortalism. It would seem that More's strategy in this refutation was to go some way towards meeting them. Like them, he accepts that 'even the purest Angels have corporeal Vehicles' because any admission of 'purely Immaterial' entities would make it 'easy for the Psychopannychites to support their Opinion of the Sleep of the Soul':

For the Soul being utterly rescinded from all that is corporeal, and having no vital union therewith at all, they will be very prone to infer, that it is impossible she should know any thing ad extra, if she can so much as dream. For even that power also may seem incompetent to her in such a state, she having such an essential aptitude for vital union with Matter.⁴⁸

More's explanation of punishments or rewards in the 'middle-state' of souls (to use White's phrase)⁴⁹ between death and the general resurrection is reminiscent of the

Blackloists' attempts to avoid the heresy of mortalism in that it relies upon the torments or satisfaction of the individual's conscience. However, More's conception, is much more consistent than that of the Blackloists. While Digby and White, together with Descartes, Hobbes and Gassendi, consider memory to be a faculty associated with body or, at the highest level, the animal or sensitive soul,⁵⁰ More insists that memory is essential to the individual soul in all its levels. Having insisted upon this it is now perfectly legitimate for More to suppose that the torments of a guilty conscience or the bliss of a clear conscience continue in the soul after death.⁵¹ More, having begun to undermine mortalism in this way, went on to consider the grounds for apocalyptic expectations. More finds the arguments for an imminent end of the world untenable on rational grounds and concludes that speculation about any Last Day is beyond the bounds of 'natural Light and Philosophy'.⁵² More's conclusion to the whole treatise, then, is that souls endure a heaven or a hell immediately after the death of the body. Souls in torment are held in the aëreal mode and sometimes appear as ghosts, while the rewarded soul achieves the aethereal state:

Who after death once reach th'Aethereal Plain,
Are straight made Gods, and never die again.⁵³

More's purpose in describing such a materialistic

eschatology is to render normally abstruse theological doctrines easily intelligible to the common man:

So in my description of the state of the other world, I am not very solicitous whether things be just so as I have set them down: but because some men utterly misbelieve the thing, because they can frame no particular conceit what the Receptions and Entertains of those Aerial inhabitants may be, or how they pass away their time; with many other intricacies which use to entangle this Theory; I thought it of main concernment to take away this Objection against the Life to come (viz. That no man can conceive what it is, and therefore it is not at all, which is the ordinary Exception also against the Existence of all Incorporeal Substances) by a punctual and rational Description of this future state.⁵⁴

It should be perfectly clear from all this that More wholeheartedly adopted the Cartesian philosophy and its three 'elements' or consistencies of matter and used them to develop an original pneumatology and eschatology. In so doing he extended the materialist side of the Cartesian duality to absorb those things which Descartes thought of as immaterial, non-spatial res cogitans. This being so, we have every reason to suppose that More's 'spirit of nature' was conceived in a similarly materialistic way. If this conclusion must remain speculative, I believe it can be demonstrated that the 'spirit of nature' is more Cartesian in its conception than has previously been realised. We will return to this in Section 2.

Walter Charleton is not so explicit about his ideological intentions as Henry More, but, providing we look at the Physiologia within the context of Charleton's whole output, it is not difficult to see what those intentions were. Charleton's first work of philosophy is highly significant for illuminating his designs. The darknes of atheism dispelled by the light of nature (1652) is sub-titled a physico-theologicall treatise and it is remarkable for being the first of the genre which was to become so popular later in the century.⁵⁵ The whole work is a sustained and systematic account of the various arguments from design. 'The heart of a pismire is more magisterial than the Eschurial', Charleton claims, 'the proboscis of a flea more evident of industry in its construction than Roman Aqueducts or the Arsenal at Venice'.⁵⁶ Subsequently he insists that 'the meanest piece of nature throwes disparagement and contempt upon the greatest masterpiece of Art'.⁵⁷

In the preface to this work Charleton tells us that since religion and the authority of the Church have been shattered by 'our Fatall Civil Warr', he determined 'to erect an intire Fabrick of Physicall Science upon Principles which seem to our judgement to be the most solid and permanent'. In so doing he hoped to establish the existence of God because 'no one thing in nature can be known, unless the Authour of Nature

be first knowne'.⁵⁸ That such an enterprise is a fit one for a philosopher rather than a divine he justifies on the grounds that 'a Natural man, persisting in the state of infidelity' will not be persuaded by Scripture but only by 'Reasons Apodictical'.⁵⁹ The new mechanical philosophy evidently seemed the ideal medium for accomplishing this conversion of all atheists. This is best illustrated by a long quotation which sums up the main themes of the Darknes of atheism.

Suppose we, in short, that God in the first act of his Wisdome and Power, out of the Tohu, or nothing, created such a proportionate congeries, or just mass of Atoms, as was necessary to the constitution of the Universe: suppose we also, that all those Atoms, in the instant of their creation received immediately from God a faculty of self-motion, and consequently of concurring, crowding, justling, repelling, resiliation, exsiliation, and reciprocal complectence, concatenation, revinction, & c. according to the respective preordination in the Divine intellect: and then will all the subsequent operations of nature remain so clear and easie, that a meer Ethnick by the guidance of these two lamps, Sense and Ratiocination, may progress to a physical theory of them, and thereby solve all the Phaenomena's [sic] with less apostasie from first Principles proposed, then by any other hypothesis yet excogitated. A meer Ethnick, I say; for we, who have devolved unto us the inestimable blessing of Moses history of the creation, have far other thoughts of that method or order, wherein the World was founded and finished by God: but the pure Natural Man, who wants the illumination of sacred writ, can follow no other conduct, but what, by the light of nature, appears most consonant to truth.⁶⁰

Charleton's next published work (two years later) was the Physiologia. On the face of it this seems to be a straightforward exegesis of the Epicurean philosophy

as revived (and Christianized) by Pierre Gassendi, it is hard to detect any ideological intentions in it. However, the title page somewhat mysteriously announces that the Physiologia is 'The First Part' of a longer work. Furthermore we are told at the end of the book that Charleton hopes to follow-up this treatise on body with a second treatise on the soul:

without which this first must be imperfect; and that is for a description of the nature of that ... which we know to be within us ... the Humane Soul.⁶¹

Unfortunately, Charleton never managed to supply 'the second part' of his treatise in the form he would have wished. What we do have, however, is a (presumably) much lighter work entitled The immortality of the human soul, demonstrated by the light of nature. In two dialogues.⁶² It is in this work that we learn the reasons for Charleton's failure to complete his original plan. After a catalogue of woe Athanasius, Charleton's mouthpiece in the dialogue, sums up: 'In a word ... for almost these two last years, I have been continually toss'd up and down by a Tempest of Calamity'.⁶³ Even so, it is safe to assume that what Charleton presents in these dialogues is something like what he would have said at greater length were it not for the Civil wars and the machinations of his enemies.⁶⁴

At the outset of his discussion Charleton (Athanasius)

declares it to be an ineluctable fact that the soul's immortality follows naturally from its immateriality. The argument is entirely similar to that of Digby in the Two treatises: dissolution is a process of breaking down into parts. What lacks matter must also lack parts and so cannot be dissolved.⁶⁵ The immaterial soul could only be destroyed by total annihilation but only God could do this (by the opposite process to his creation ex nihilo). Lucretius, the second interlocutor (modelled on Charleton's friend John Evelyn, 1620-1706), makes a series of objections to this idea but Athanasius deals with them all. Immortal material bodies, like celestial bodies, for example, are declared to be immortal only by the grace of God, while the soul is naturally immortal.⁶⁶ The dialogue proceeds by seeking to establish the premise that the soul is immaterial.

The arguments are clearly derived, as we might expect, from Gassendi, Descartes, and Sir Kenelm Digby.⁶⁷ Unfortunately, due to the abbreviated nature of the treatise Charleton does not develop an eschatological doctrine. The state of the soul after death is raised by Lucretius who asks how the disembodied soul can know anything without sense organs to attain knowledge. Athanasius dismisses this as a mere confusion of knowledge with sensation - knowledge, he adds, is understanding not perception. At this point,

significantly, Athanasius refers Lucretius to Digby's speculations on the condition of a separate soul.⁶⁸

If we consider the dialogues on The immortality of the soul to be an intimation of a more substantial work which was to be the sequel to the Physiologia then it is easy to see that Charleton's advocacy of Gassendist atomism was designed to play an ideological role. Other works by Charleton tend to confirm his awareness of the ideological power of natural philosophy. In one of his later works he tried to show The harmony of natural and positive Divine laws and, as the publisher's preface says:

it was written by the Author to no other end, but to confirm his Faith by inquiring into the Reasonableness and Purity of it, and to augment his piety toward God. In a word that he might offer to the Divine majesty, not the sacrifice of Fools, but ... Worship consentaneous to right reason.⁶⁹

Furthermore, Charleton's single contribution to the new discipline of archaeology,⁷⁰ the Chorea gigantum of 1663, seems to have been written as a 'Politick' exercise to demonstrate the antiquity of the concept of constitutional monarchy.⁷¹

Clearly, Charleton was no stranger to the idea of using intellectual argument to promote a particular ideological position and it is, therefore, safe to conclude that Gassendi's version of the new philosophy was popularized

in England as a result of his efforts at just the same time that Henry More was popularizing the version of Descartes and with similar ideological intentions. Indeed, although Charleton's reputation stands not so high as More's today, there is good reason to believe that during the Interregnum and the early years of the Restoration period, Charleton was more likely to win converts than the Cambridge Divine. In order to understand why this was, however, we must first consider an extremely important aspect of seventeenth-century intellectual life.

Thanks largely to the work of Richard H. Popkin it is now recognised that scepticism played a crucial role in the development of the early modern world-view. More specifically, the intellectual movement described by Popkin as 'constructive scepticism' played a dominant role in the scientific revolution and contributed more than any other single factor to the development of the new corpuscular, mathematical and experimental philosophies of the seventeenth century.⁷² The leading figure in this scientific wing of the new sceptical movement was the Minim friar, Marin Mersenne (1588-1648), who has not unjustly been seen as the man who gave birth to the mechanical philosophy.⁷³ Mersenne's circle of intellectual friends included both Descartes and

Gassendi as well as Hobbes and Digby. During the Civil War period in England and the early years of the Interregnum many royalist English thinkers converged on Paris to be near their king, the young, uncrowned Charles II. A number of these thinkers were introduced, probably by Hobbes, into Mersenne's circle. The new members of this circle of natural philosophers included for a time William Petty, John Evelyn and Walter Charleton.⁷⁴

Now, Mersenne himself was not interested in natural philosophy merely for its own sake or through idle curiosity. He saw it as a safe and essential means to combat atheism and to settle the religious disputes of his age. Not surprisingly, he influenced all the leading members of his circle to see natural philosophy in the same way. Mersenne's earliest efforts along these lines were typical of other Catholic thinkers in so far as they were uncompromisingly dogmatic. Reason, and in particular the arguments of natural philosophy were used to bolster the teachings of scripture and tradition.⁷⁵ Descartes, an early associate of Mersenne and a thinker who shared with him the experience of a Jesuit education at La Flèche, also took up this dogmatic use of natural philosophy to counter atheism and heresy.⁷⁶

However, as a result of what Popkin sees as a sceptical crisis in early modern thought, Mersenne (unlike Descartes) soon developed the position of 'constructive or mitigated scepticism'. Mersenne's major ally in this enterprise was not Descartes but Pierre Gassendi.⁷⁷ Mersenne and Gassendi recognised that no dogmatic argument could prevail against the negative attitudes of the committed Pyrrhonist. They forestalled the extreme and nihilistic sceptical arguments, therefore, by going some way to meet them and admitting that certain knowledge could not be achieved. Nevertheless, they insisted that there were sufficient pragmatic grounds for accepting many beliefs as true until God should reveal the truth to us. Gassendi's work on the Epicurean philosophy, therefore, was a prolonged exercise in hypotheticalism. Gassendi was not seeking to establish the truth about reality but merely about appearances.⁷⁸

The new tradition of constructive scepticism became extremely important in seventeenth-century England. In the early part of the century it was used to great effect by William Chillingworth, Viscount Falkland and others to defend Protestant theology against the dogmatism of Roman Catholicism.⁷⁹ During the turbulent years of the 1640s and 50s constructive scepticism became an essential and effective weapon in the fight against

unorthodoxy in religion.⁸⁰ The real threat to the stability of society in these years was seen to come from various kinds of dogmatists. Apart from Roman Catholics there were numerous fanatical or 'enthusiastic' religious sects who all claimed to have a monopoly on truth. That these enthusiastic sects were subversive there can be no doubt. Generally finding their adherents among the poor and lower classes, if not the entirely dispossessed, they tended to take up extremist political positions like antinomianism.⁸¹ A further dogmatic stance which was considered by the orthodoxy to be totally subversive of any civilized society was atheism. Paradoxically, atheism was not seen as a form of extreme scepticism but tended to be regarded rather as one more subversive, antinomian sect. As Henry More put it: 'Atheism and Enthusiasm, though they seem extremely opposite one to another, yet in many things they do very nearly agree'.⁸²

In view of the association of any dogmatic stance with subversive movements it is not difficult to see why mitigated scepticism became the predominant philosophical outlook among English intellectuals. Thomas Browne declared that 'the wisest heads prove, at last, almost all Scepticks',⁸³ and it is easy to find many such wise heads among seventeenth-century English thinkers, from divines to natural philosophers. For such men scepticism essentially involved a suspension of judgement

on controversial issues.⁸⁴ The best we can hope for, they would have claimed, is to reach a position which enables us to be reasonably confident of what we know for all practical everyday purposes. Clearly, this attitude will guarantee a 'common-sense' approach which is unlikely to lead to any change in the status quo. Ever mindful of the excesses of the radical sects, the comparatively well-off intellectual would have affirmatively answered Montaigne's question: 'Is it not better for a man to suspend his own persuasion, than to meddle with sedicious and quarrelsome divisions?'.⁸⁵ Pierre Bayle, saw straight through to the heart of the matter when he declared that 'Pyrrhonism ... is not very dangerous with respect to Natural Philosophy or the state'.⁸⁶

In view of all this it is reasonable to assume that if Henry More and Walter Charleton were to have any immediate influence on philosophical thought they would have to take up the cause of constructive scepticism. Walter Charleton recognised this much earlier than More and I believe that this may have increased Charleton's influence. Charleton's earliest appearances in print show the strong influence of John Baptista van Helmont (1579-1644) the spagyric chemist. Alchemists and

other occult philosophers, as P.M. Rattansi has shown, tended to be associated with enthusiasm.⁸⁷ For example, Thomas Hall (1610-1665), a presbyterian minister, attacked the radical John Webster (1610-1682) for being of the 'Familiasticall-Levelling-Magical temper', as shown by his advocacy of Paracelsus and his belief in private spiritual illumination.⁸⁸ In 1650 Charleton would have been open to the same charge (though it would certainly have been unjust).⁸⁹ However, by 1654 with the appearance of the Physiologia, Charleton established himself as a hypotheticalist philosopher acceptable to even the most orthodox.⁹⁰

Charleton repeatedly insists that his philosophy is 'at most but ingenious conjecture' and that his ambition is only to take 'the copy of Nature from her shadow, and from the reflex of her sensible Operations to describe her in such a symmetrical Form, as may appear most plausibly satisfactory to the solution of all her Phaenomena'.⁹¹ Perhaps the most explicit and most memorable statement of Charleton's probabilism appears in the closing words of the Physiologia:

I conjure you, by your own Humanity to remember and testifie, that in this my Conversation with you, you have found me so far from being Magisterial in any of the Opinions I praesented; that considering my own Humor of Indifferency, and constant Dubiosity (frequently professed ...) it hath somewhat of wonder in it that I ever proposed them to Others:

nor, indeed, can anything solve that wonder,
 but my Hopes, thereby secretly to undermine that
 lofty Confidence of younger Heads, in the
 Certitude of Positions and Axioms Physiological;
 and by my declared Scepticism even in such Notions,
 as my self have laboured to assert by the firmest
 Grounds and strongest Inducements to Belief, to
 reduce them to the safer level of

Quo magis quaerimus, magis dubitamus.⁹²

By contrast, although Henry More was always alert to the dangers of religious enthusiasm,⁹³ he was slow to realise the dangers lurking in the dogmatic approach of Cartesianism. Writing in 1647, More chided those who prefer 'that sad ground of incredulity before anything lesse than a Demonstration',⁹⁴ and over ten years later in The immortality of the soul he still shows contempt for scepticism:

it is a disease incurable and a thing rather to be pitied or laught at, than seriously opposed. For when a man is so fugitive and unsettled, that he will not stand to the verdict of his own Faculties, one can no more fasten anything upon him than he can write in the water or tye knots of the wind.⁹⁵

More's answer to sceptics was to proceed rationally from various axioms and to declare that he had thereby 'demonstrated with evidence no less than Mathematical'.⁹⁶

By 1665, however, More had finally realised the danger implicit in Cartesianism: its dogmatic claims to truth can be used to repudiate all instances of fideism and to bolster an atheistic view of the world. More's

distress about his failure to notice this sooner is evident in a letter he wrote to Robert Boyle:

I have, from my very first letters to Des Cartes, till this last book of mine Enchiridion metaphysicum, always expressed my opinion, that this mechanical way would not hold in all phaenomena, as I always verily thought but this would not save us from being accounted amongst the wits, one of their gang; and a perfect Cartesian, as to the hypothesis; and, indeed, no less than an infidel and atheist. And I was informed ... that a considerable company of men appeared ... mere scoffers at religion, and atheistical, that professed themselves Cartesians: and that his philosophy may naturally have such an influence as this, I can neither deny, nor could conceal in my preface to this book; for it had been to the prejudice of religion, and to my great reproach, for me, who have been, from my youth to this very day, so open a stickler for the support of natural religion, and for Christianity itself, in the best mode thereof, to be found of so little judgement as not to discern, how prejudicial Des Cartes's mechanical pretensions are to the belief of a God. Certainly, all those of the atheistical party, that have observed my zeal in the behalf of religeon, in almost all my writings, must, as once I heard a known physician say of them of our profession, that God has sent none but a company of fools upon his errand, take me to be one of the chief of them; or think me a juggler and deceiver, I not declaring against that philosophy which is the pillar of many of these men's infidelity, and of their atheism.⁹⁷

More was too optimistic in supposing that only scoffers and 'wits' would think him an atheist. Robert Boyle himself, though always reluctant to become embroiled in personal polemics, saw distinct atheistical implications in Henry More's interpretation of nature and was moved sufficiently to say so in print and at some length in his Free inquiry into the vulgarly received notion of nature.⁹⁸ Boyle's anxiety about

More's dogmas, as J.E. McGuire and others have shown, stemmed from his belief that the 'hylarchic principle' could be interpreted in a Spinozistic way as a god in nature - in short, it could lead to pantheism.⁹⁹ The same anxiety is briefly alluded to in Boyle's Hydrostatical discourse of 1672. Objecting to More's 'hylarchic principle' Boyle declares:

truth ought to be pleaded for only by truth; so I take that which the doctor contends for, to be evincible in the rightest way of proceeding by a person of far less learning than he, without introducing any precarious principle; especially experience having shewn, that the generality of heathen philosophers were convinced of the being of a divine architect of the world ...¹⁰⁰

Boyle makes it perfectly clear that the way to avoid all such 'precarious principles' is to curtail all tendencies to dogmatism:

if I had been with those Jesuits, that are said to have presented the first watch to the king of China, who took it to be a living creature, I should have thought I had fairly accounted for it, if, by the shape, size, motion, & c. of the spring-wheels, balance, and other parts of the watch I had shown, that an engine of such a structure would necessarily mark the hours, though I could not have brought an argument to convince the Chinese monarch, that it was not endowed with life.¹⁰¹

According to Boyle, therefore, More's dogmatism, though different from Descartes', was equally dangerous. Only a circumspect scepticism was unlikely to lead one astray.¹⁰²

The fact that Descartes was regarded by most English thinkers as a dangerous dogmatist can hardly be denied in spite of the efforts of the historian and philosopher

of science, Laurens Laudan, to demonstrate that Descartes was regarded as a probabilist.¹⁰³ Laudan's attempt to show that it was due to Descartes' influence that hypotheticalism became the predominant methodology of science between 1650 and 1665 suffers primarily from insufficient knowledge of the historical background. In particular Laudan shows no knowledge whatsoever of Pierre Gassendi's influence. Fortunately, a useful corrective to Laudan's thesis was quickly provided by G.A.J. Rogers.¹⁰⁴ Rogers was easily able to show that Descartes was by no means a probabilist but even he did not point to the real influence behind English methodological thought.

The evidence that Laudan produces to indicate that Boyle and Joseph Glanvill, both undeniably sceptical in their approach,¹⁰⁵ derived their probabilism from Descartes is a case of putting the cart before the horse. Glanvill and Boyle were both continually engaged in composing apologetics for the new philosophy in order to refute the numerous charges of atheism brought against it. Since dogmatic thinkers were always suspected of atheistic (or heterodox) intentions it was important to claim that Descartes was not a dogmatist.¹⁰⁶ If we look at writers not concerned to defend the new philosophy we get a far more representative picture. Edward Stillingfleet (1635-1699), Bishop of Worcester, presented a fair account of Descartes' attitude in his Origines sacrae:

... sometimes he is content to let it pass as a bare Hypothesis, agreeing with the Phaenomena of the World; but withal he saith, That he makes use of no Principles but such as are most evident, and deduces nothing from them but by Mathematical consequences. And in an Epistle to Mersennus, to whom he opened his Mind more freely, he saith, That he should think he knew nothing in Physicks, if he could only tell how things might be, if he could not demonstrate that they could be no otherwise.¹⁰⁷

Meric Casabon (1599-1671), another Churchman and son of the famous scholar Isaac Casaubon, was more caustic about Descartes' method:

But for his Method: I tooke him for one, whom excessive pride and self-conceit (which doth happen unto many) had absolutely bereaved of his witts. I could not beleieve that such stuffe, soe ridiculous, soe blasphemous (as I apprehended it, and doe still) could proceed from a sober man. A cracked brain man, an Enthusiast, such a one as Acosta gives us the relation of ...¹⁰⁸

On the other hand, Casaubon always speaks highly of Gassendi and applauds in particular his denunciation of Descartes in the Disquisitio metaphysica. According to Casaubon, Gassendi 'doth lay him open very sufficiently: more need not be said by any man to show the vanitie, futilitie, nugacitie, of that confident, if not brainsick undertaker'.¹⁰⁹

There can be little doubt, then, that the vogue for constructive scepticism in both theology and natural philosophy assured that the philosophy of Gassendi drew at least as much attention as that of Descartes in spite of its lack of originality.¹¹⁰ Charleton's early translation of Gassendi's philosophy into English would

have appealed, therefore, to those, like Glanvill and Casaubon, whose attitude was one of cautious **scepticism**. Foremost among those known to have been influenced by Charleton's Physiologia were Robert Boyle and Isaac Newton.¹¹¹

One final point remains to be emphasised about the ideological background to the rise of the new philosophy and its corpuscular matter theory. As we said at the beginning of this chapter, both More and Charleton were staunchly committed Anglicans. Neither of them could be accused of trimming or compromising their beliefs in any way. Henry More is known even to have used the Anglican liturgy in public as well as private at a time when it was forbidden by law.¹¹² Charleton was raised by Anglican parents and was always loyal to the monarchy, taking no advantage at all during the Interregnum. He seems genuinely to have regarded even the licentious Charles II as the devoted head of the Church.¹¹³ If it is true, as we have argued, that these two men played the largest individual roles in inaugurating the mechanical philosophy into the mainstream of English philosophical thought,¹¹⁴ it follows that the thesis that the scientific revolution in England was brought about by Puritan thinkers is, once again, seriously questioned.

We have already pointed-out that the earliest contributors to the development of the mechanical philosophy in England, Digby, White and Hobbes severely undermines the Puritanism-

and-science thesis. Digby and White were Catholics, while Hobbes must be counted, like More and Charleton, as an Anglican. Although Hobbes' religious position suggests some Puritan features, his mortalism and insistence upon Biblical literalism for example, it can hardly be denied that one of the major endeavours of his political writings was to establish the monarch as the head of a state church.¹¹⁵

So, the major figures in the establishment of the theoretical foundations of the English scientific revolution were anything but Puritan (no matter how loosely the term Puritan is defined).¹¹⁶ In fact, advocates of the Merton thesis have always had to rely upon a vision of science as a strictly practical (in the most mundane sense), utilitarian endeavour which is far more reminiscent of technology than it is of natural philosophy.¹¹⁷ Even Charles Webster, whose Great Instauration is the most consistent and persuasive work in this genre, has to admit that the view of science he portrays may not be recognisable as science to the modern reader.¹¹⁸ He admits that he has been concerned with the 'technical, utilitarian' dimension of science and not with what he calls 'serious scientific work' by which, presumably he means theory construction.¹¹⁹ We have already seen in Chapter 4 that Webster's mistaken insistence upon the prevalence of utopian millenarianism (as opposed

to a more unearthly apocalypticism) derives from his need to establish his thesis.¹²⁰ Similarly, it seems that the attention some historians have paid to the role of Francis Bacon in the scientific revolution is to serve the same ends. The utilitarian aspects of Bacon's pronouncements are seized upon and exaggerated at the expense of the rest of his thinking.¹²¹ Alexandre Koyré has defined the true role of Bacon as 'completely negligible' and, if that is taking it too far, it certainly emerges from Van Leeuwen's researches into the sceptical background to English methodology that Bacon's role has been somewhat overinflated.¹²²

While the Hartlib circle and a few other 'Puritan' thinkers who form the core of Webster's researches can be seen to be engaged upon utilitarian utopian schemes the overall impact of these endeavours on broader developments is in some doubt. There is plenty of evidence to suggest that utilitarian schemes were rejected or ignored by scientifically inclined intellectuals. Indeed, it should not be forgotten that for many at this time 'usefulness' was defined in terms of the moral and religious purposes to which science could be put, not its ability to improve the life-style of the artisan.¹²³ If we take the strong line recently adopted by the Newtonian scholar, Richard S. Westfall, and insist that it is impossible 'to

describe such empirically derived knowledge and practices, which had no connection with a theoretical framework, as part of science', then we can finally reject the Puritanism-and-science thesis.¹²⁴ Michael Hunter has recently affirmed that 'science was always primarily a theoretical activity and its most significant contemporary milieu was therefore in intellectual life'. We can now extend this to say that the specific milieu for the development of theoretical science, even in the days of the Puritan commonwealth, was Anglican.¹²⁵

2. Henry More and the spirit of nature.

We turn now to consider some of the details of Henry More's doctrines of natural philosophy and the implications these had for the peculiar development of the mechanical philosophy in England. It is usually believed that, although More popularized the Cartesian philosophy in England, his own understanding of it was somewhat inadequate. We must bear this opinion in mind as we proceed before making a judgement upon it, but it can be admitted straight away that, as Marjorie Nicolson has pointed out, More 'found in his great contemporary less what he sought than what he brought'.¹²⁶ The point is that More's great enthusiasm for the Cartesian system derived from the very beginning from More's belief that Cartesian mechanism simply could not explain all

physical phenomena. He was so sure of this himself that he believed it would be obvious to all students of the mechanical philosophy. Once the fundamental inadequacy of the explanatory power of strict mechanism was noticed, More believed, the natural philosopher would have to rely on some kind of 'spiritual' entity in his explanations. It was for just this reason that More recommended the teaching of the Cartesian system in Universities:

That the Students of Philosophy may be thoroughly exercised in the just extent of the Mechanical Powers of Matter, how farre they will reach, and where they fall short. Which will be the best assistance to Religion that Reason and the Knowledge of Nature can afford.¹²⁷

The 'rational and religious' mind, More believed, would be forced to conclude that strictly mechanical explanations left crucial lacunae in any explanation of physical phenomena and these could only be breached by the introduction of an immaterial 'Spirit of Nature'.¹²⁸

By now, it should come as no surprise to learn that More introduced the spirit of nature into the Cartesian system in order to account for motion and activity.

Although More accepts that 'Matter it self once moved can move other Matter'¹²⁹ he insists that matter 'is not active of it self, because it is reducible to rest'.

This last point, he claims, 'is an Argument not only that Self activity belongs to a Spirit, but that there

is such a thing as a Spirit in the world'. Anyone who denies this and insists that there is nothing but Matter, according to More, 'must of necessity (as I have intimated already) confess that this Matter moves it self, though it be very incongruous so to affirm'.¹³⁰

So, the spirit of nature is the active principle in More's universe which operates on 'inert and stupid' matter¹³¹ to produce the various phenomena of the world:

I ask ... if there be not in nature an incorporeal substance which, while it can impress on any body all the qualities of body, or at least most of them, such as motion, figure, position of parts, etc ... would be further able, since it is almost certain that this substance removes and stops bodies, to add whatever is involved in such motion, that is it can unite, divide, scatter, bind, form the small parts, order the forms, set in circular motion those which are disposed for it, or move them in any way whatever, arrest their circular motion and do such similar things with them as are necessary to produce ... light, colours and the other objects of the senses ...¹³²

What we must try to do is understand precisely how More envisaged this spirit of nature.

So far, we have noticed in our so-called 'mechanical philosophies' a tendency to rely upon the neo-Platonic and medieval tradition of light-metaphysics (albeit in an adapted form) to provide an active, self-moving principle.¹³³ If this was so pervasive in the natural philosophy of the time, we should certainly expect More, who traced his philosophy 'over the high and aery hills of Platonism'¹³⁴ to make use of the tradition. We shall pursue this possibility first.

When More published the second, enlarged, edition of his Antidote against atheism he added a lengthy Appendix to answer 'certain Objections' made against the first edition.¹³⁵ One of these objections was that More's concept of a spirit contained a fundamental inconsistency because it was said to be both extended and indivisible. More's response was to 'represent the property of a Spirit in this Symbole or Hieroglyphick', or, as we would say, with a revealing analogy.

Suppose a Point of light from which rays out a luminous Orb according to the known principles of Opticks: This Orb of light does very much resemble the nature of a Spirit, which is diffus'd and extended, and yet indivisible.¹³⁶

More points out that although a luminous sphere of light emanating from a central point is extended it is absurd to imagine that one luminous ray could be separated from the rest 'by any Engine or Art whatsoever'. In short, 'the parts of a Spirit can be no more separated, though they be dilated, then you can cut off the Rayes of the Sun by a pair of Scissors made of pellucid Crystall'.¹³⁷

In order to get the most force from this analogy More has to deny the Aristotelian definition of light as merely an accidental modification of the medium and insist that light is, in fact, a substance in the same manner as spirit.¹³⁸ Accordingly, he continues:

... there is no difficulty to imagine such an Orb as this a Substance as well as a Quantity. And indeed the Sphere of light it self, it not

inhering in any Subject in the space it occupies, looks far more like a Substance than any Accident. And what we fancie unadvisedly to befall Light and Colours, that any point of them will thus ray orbicularly, is more rationally to be admitted in Spiritual substances, whose central essence spreads out into a Secondary substance, as the luminous rays are conceived to shoot out from a lucid Point.¹³⁹

This distinction between 'central essence' and 'secondary substance' shows that More has found a new use for the old distinction of light metaphysicians between the lux inhering in a shining body or point and the lumen or 'brightness' which spreads out beyond. More can now use this distinction and a further analogy to overcome another objection to his initial theory. Evidently More's concept of spirit was said to involve a property of self-generation or creation ex nihilo. In the Appendix More repudiates this interpretation by means of the following analogy:

It is manifest that ... rays [of light] that are hindred from shooting out so far as they would, need not lose their virtue or Being, but only be reflected back toward the shining Center; and the obstacle being removed they may shoot out to their full length again: so that there is no generation of a new ray, but an omission of what was actually before.¹⁴⁰

The analogy between light and the spirit of nature is so close that More is reluctant to lay it aside. Four years later, in The immortality of the soul he takes it up again and embellishes it. He introduces it for the same reason as before: as an example of an

entity extended yet indivisible or, as he usually says, indiscerpible. However, he also tells us that the 'secondary substance' of the spirit of nature is able to 'actuate grand Proportions of matter' as it emanates outward in a 'sphere of life and activity'.¹⁴¹ In order to explain how such a substance could 'actuate' matter, More simply makes it an axiom that any 'Emanative Cause' is 'such a cause as merely by Being, no other activity or causality interposed, produces an Effect'. He insists that there must be such a cause in the world because 'something must move it self'.¹⁴²

More's spirit of nature, therefore, is conceived of in two modes, a 'Primary or Centrall Substance' and a 'Secondary or Emanatory Substance',¹⁴³ which is capable of transmitting motion or activity to inert matter merely by its presence. This is entirely reminiscent of traditional light metaphysics which, as mentioned above, distinguishes between lux and lumen and also regards light, if not as a causative principle, as a universal formative principle.¹⁴⁴

Significant though these parts of More's discussion are for this thesis, the fact remains that they are merely close analogies. More never slips into treating his spirit of nature as light itself. He is always careful to maintain a strong distinction between them. It is not possible to be certain as to why this is so.

It may be that More would have regarded an unreconstructed version of light metaphysics as too mystical for him and more the preserve of neo-Platonist thinkers like Robert Fludd or Thomas Vaughan.¹⁴⁵ Alternatively, it may well have been that More was aware of the way in which light had been used by Hobbes and Digby as a kind of self-active matter- a position which More was always concerned to deny.¹⁴⁶ We are not much nearer, therefore, to understanding the intellectual antecedents of More's concept.

A careful consideration of some of More's other pronouncements on the spirit of nature, however, reveals some particularly intriguing features of his concept which have not previously been noticed. It is immediately obvious to the reader of More's works that the spirit of nature is in some sense an intermediary between God and matter - a means by which God may be said to act in the universe and yet, at the same time, to maintain a certain level of transcendence.¹⁴⁷ This is evident, for example, in this passage from The true notion of a spirit:

One [property] at least every Spiritual Substance hath: as also the faculty of moving; insomuch that every spirit either moves it self by it self, or the Matter, or both, or at least the Matter either mediately or immediately; or lastly, both ways. For so all things moved are moved by God, he being the Fountain of all Life and Motion.¹⁴⁸

Similarly, we are repeatedly told that the Spirit of Nature is 'the vicarious power of God' upon the universe.¹⁴⁹ Furthermore, after one of his more lengthy explications of Spirit as the motive principle in matter, More concludes:

That no matter whatsoever of its own Nature has any active Principle of Motion, though it be receptive thereof; but that when God created it, he superadded an impress of Motion upon it, such a measure and proportion to all of it, which remains still much-what the same for quantity in the whole, though the parts of Matter in their various occursion of one to another have not alwaies the same proportion of it ...

More goes on to say that God need only conserve the matter and 'the Matter thus conserved will faithfully retain one part with another, the whole summe of Motion first communicated to it'.¹⁵⁰ Remarkably, the spirit of nature seems to have receded entirely and More's account of motion has become indistinguishable from Descartes'.

This cannot be written-off as a momentary lapse on More's part. In 'The Preface general' written for the collection of his philosophical writings in 1662 he takes a similar (if not quite so obvious) line. The spirit of nature is described as:

a mute copy of the eternal Word (that is, of that Divine Wisedome that is entirely everywhere) is in every part naturally appointed to do all the best services that Matter is capable of ... according to that Platform of which it is the Transcript, I mean according to the comprehension and Purpose of those Idea's of things which are in the eternal Intellect of God.

The crucial point about the particular definition is that it leads More to say that spirit 'is the lowest Substantial Activity from the all-wise God, containing in it certain general Modes and Lawes of Nature'.¹⁵¹

The spirit of nature, therefore, seems to be nothing more than a complex concept which can be analysed into two or three simpler Cartesian concepts: an initial impetus given to the world by God, and the conservation of transference of that initial input of activity according to laws of nature.

There are further suggestions that More is not so far removed from Descartes as is generally believed. He always insists that the spirit of nature operates blindly without perception or intelligence. He takes his best demonstration of this from Boyle's experiments with the air-pump. If the receiver of the pump is fitted with a valve, the air trying to beat its way back into the receiver after evacuation will shut the valve and so strongly that 'it will bear up with it a ten-pound weight'.¹⁵² This kind of 'self-thwarting' activity clearly shows that 'Aire it self' has no 'Power, Knowledge, and liberty of will', 'nor that there are any such Divine particles interspersed in the Aire that have'. More's conclusion, in the best traditions of the mechanical philosophy is 'that the Impetus of Motion

in all matter is blinde and necessary, and that there is no Matter at all that is free and knowing but moves and acts of it self ... according to the mere Mechanical laws of Motion'.¹⁵³

In view of this it would seem that More was perfectly justified in denying that he had 'introduced an obscure Principle for ignorance and Sloth to take sanctuary in, ... and hinder that expected progress that may be made in the Mechanick Philosophy'.¹⁵⁴ He was surely correct in saying that Descartes had taken the mechanical philosophy as far as it could go and that More's own contribution was not to undermine it but to refine it:

Nor needs the acknowledgement of this Principle [the spirit of nature] to damp our endeavours in the search of the Mechanical causes of the Phaenomena of Nature, but rather make us more circumspect to distinguish what is the result of the more Mechanical powers of Matter and Motion, and what of an Higher Principle.¹⁵⁵

It is easy with hindsight to see that More was correct about the non-mechanical origins of gravity - one of his favourite examples.¹⁵⁶ A less obvious example is his account of condensation and rarefaction. More accepted the universal belief that matter is mutually impenetrable, and he also accepted the atomists' belief that the particles of matter cannot change their individual sizes and densities. Rarefaction, therefore,

has to be explained in terms of increased distance, and condensation by decreased distance between the particles. The problem is, how are the particles kept apart in the case of rarefaction? More's spirit is perfectly capable of altering a body from within because all alteration is 'nothing else but the varying of either the Figures, or postures, or the degrees of motion in the particles'.¹⁵⁷ In the case of rarefaction and condensation the alteration in the arrangement of the particles is brought about by a particular property of the spirit which More calls 'essential Spissitude'. More is simply taking advantage of the self-penetrative power of spirit; unlike matter, spirit can redouble itself into more space or contract itself into less - as it does so it may hold apart or bring together the particles of matter around it.¹⁵⁸

It would seem, then, that More did not misunderstand Descartes, as some scholars have implied, and nor was he biassed against the mechanical philosophy merely because of his religious views.¹⁵⁹ He understood Descartes well enough and was quick to see that the mechanical philosophy really did have its limitations. Not merely because it could not explain sympathetic resonances in strings or sympathetic cures but also because it could not explain magnetism, gravity,

condensation and rarefaction and various other phenomena.¹⁶⁰

We said earlier that More was of the opinion that those who repudiated his concept of spirit must 'confess that ... Matter moves it self'.¹⁶¹ We will turn now to consider More's companion in bringing European mechanical philosophies to the attention of the English public, and we will see whether More was correct in his judgement.

3. Walter Charleton and active matter.

Charleton has been described as an accurate 'barometer' of the various trends in seventeenth-century science¹⁶² and a recent important article on Charleton has tried to amplify and illustrate this by outlining his intellectual development.¹⁶³ According to this article, Charleton's work can be seen to undergo a dramatic change between 1650 and 1654, from an 'overwhelmingly Renaissance-alchemical flavour' to a 'blatantly atomistic' and 'modern' approach.¹⁶⁴ Unfortunately this superficially persuasive argument is based upon an over-simplistic conception of the development of 'modernism' which we are seeking here to deny. The vitalistic elements in the earliest philosophical writings of Charleton do not give place to a thoroughgoing mechanism but remain even in his much later writings. Furthermore, the new philosophy of corpuscularian mechanism is by far the most predominant

world-view in his writings from the very beginning.¹⁶⁵

Even Rattansi's interpretation of Charleton's career, involving a change from dangerous radical Paracelsianism to the more conservative mechanism, begins to break down when considered in terms of a more subtle perspective.¹⁶⁶

We saw in section one of this chapter that the major conservative approach to natural philosophy by mid-century was that of mitigated scepticism, as opposed to any dogmatic pronouncements about the nature of truth or reality. There is a clear indication of Charleton's fundamental conservatism even in his earliest and most Paracelsian (or rather Helmontian) work when he provides the following conclusion:

All this I now assent to; but invite
Each wiser head to make me's Proselyte.
My Mercury is not fixt: My Virgin faith
Scorns to submit to what an Author saith,
Barely because he said it. To enquire,
To doubt, is to advance our judgement higher.
For I've been told, that Knowledg most doth lie
Enshrin'd in Sceptical Neutralitie.¹⁶⁷

But the major feature of Charleton's Ternary of paradoxes which gives the lie to suggestions of any fundamental change in his attitudes is its reliance on the contact action of material atoms to explain 'occult' phenomena. The first part of the Ternary is a discourse 'Of the Magnetick Care of Wounds' and deals with the care of wounds by allegedly 'sympathetic' means. The essay

itself is a translation of a piece by Van Helmont and cannot be regarded as Charleton's own views with total safety. Even so, it is worth pointing out that a 'continued thread of atomes arriving at an object seated at remote distance ...' is invoked by Van Helmont to explain that 'the power operative on a distant object is natural'.¹⁶⁸ There can be no doubt that it was just this kind of proto-atomistic explanation which engaged Charleton's interest because Charleton's own 'Prolegomena to the Candid and Ingenuous Reader' concentrates very heavily upon this kind of explanation. The major influence upon Charleton's thinking is significant in itself: Sir Kenelm Digby is described as 'the choyssest flower in our garden' and 'a noble person, who hath built up his Reasons to so transcendent a height of Knowledg, as may seem not much beneath the state of man in innocence'.¹⁶⁹ As a result Charleton's explanation of how the power of sympathy works is derived almost entirely from Digby's atomistic account of it in his Treatise on body and, like Digby's, Charleton's account could be said to be 'impeccable' by the standards of the mechanical philosophy.¹⁷⁰

Impeccable, that is, except for one crucial aspect: Charleton makes no attempt to account for the motion of his atoms. Roman vitriol, Charleton's name for the powder of sympathy, is said to be 'richly endowed' with

a 'Radial activity' which is explained to be nothing more than 'imperceptible Emissions streaming in a semi-immaterial thread of Atomes'.¹⁷¹ Charleton somewhat disingenuously claims that 'by a general consent of all the secretaries of Nature, and the undeniable testimony of trivial Experience, every mixt Body, of an unctuous composition doth uncessantly vent, or expire a circumferential steam [sic: stream?] of invisible Atomes'.¹⁷²

Two years later, in The darknes of atheism, Charleton's committment to atomism is even stronger in spite of the fact that Epicurus is vigorously denounced as one of the chiefest of 'atheistical monsters' and the 'Secretary of Hell'.¹⁷³ In spite of the 'heap of dross' the Epicurean philosophy is said to hold some 'rich metal':

I have never yet found any justifiable ground, why Atoms may not be reputed Mundi materies, the material principle of the universe, provided that we allow that God created the first Matter out of Nothing; that his Wisdome modelled and cast them into that excellent composure or figure, which the visible world now holds; and that ever since, by reason of the impulsion of their native Tendency, or primitive impression, they strictly conform to the laws of his beneplacuits, and punctually execute those several functions which his almighty Will then charged upon their determinate and specifical Creations.¹⁷⁴

While expounding the advantages of the atomist philosophy

at greater length, Charleton returns to the problem of their motions. He admits that it is an 'incongruity' of the Epicurean philosophy that atoms have 'from all eternity, a faculty of motion, or impetuous tendency, inherent in them'. However, the root of Charleton's unease lies in the phrase 'from all eternity' when Charleton 'refines' the 'hypothesis of atoms' by suggesting that God imposed their motions on them 'in the first motion of their miraculous production ex nihilo'.¹⁷⁵ Having made this refinement Charleton declares atomism to be superior to all other systems of natural philosophy because 'it fitly declares the radical Cause of all Motion, activity or energie in second causes, or natures once removed from the Primus motor, God'.¹⁷⁶

This last point dissociates Charleton's thinking from that of Descartes. Charleton does not consider that one initial impetus by God has been transferred successively according to the laws of motion, nor that God is actively and directly engaged in conserving the motion of the universe from moment to moment. The matter itself has some inherent 'faculty of self-motion' which was put there at the Creation. Charleton insists that only 'impardonable incircumspection or forgetfulness'

could account for the belief that matter is 'absolutely idle, and devoid of all motive or active virtue'.¹⁷⁷

The culmination of Charleton's endeavours to rehabilitate the Epicurean philosophy is provided in the Physiologia but there is essentially no change in his attitude to the motion of atoms. Once again he denies the Epicurean position that the 'motive faculty' of atoms has been 'eternally inherent in them', only to insist that 'at their creation God invigorated or impregnated them with an Internal Energy or Faculty Motive, which may be conceived the First Cause of all Natural Actions or Motions'.¹⁷⁸

The author of the Physiologia insists repeatedly upon motion as an essential property of his atoms: 'the third propriety of the Universal Matter, Atoms, is Mobility or Gravity: and from that fountain is it that all Concretions derive their Virtue Motive'. It follows that 'Atoms are never totally deprived of their essential Faculty, Mobility'. This innate atomic motion is, naturally, translated into larger, compound bodies: 'That same MOTIVE VIRTUE, therefore, wherewith every Compound Bodie is naturally endowed, must owe its origine to the innate and co-essential Mobility of its component particles ...'.¹⁷⁹

In effect then, Charleton has introduced into his mechanical philosophy an occult quality which, as one contemporary critic put it, outdoes 'the most credulous Peripatetics'. Edward Stillingfleet, who was much influenced by Henry More, insisted (with good reason) that to say that 'Atoms move because it is their nature to move' is 'least of all pardonable in the exploders of substantial forms and occult qualities when the Origine of the whole world is resolved into an occult quality which gives motion to Atoms'.¹⁸⁰

We have now considered all the major English thinkers involved in the earliest efforts to establish the new corpuscular natural philosophies in England prior to the Restoration of the monarchy in 1660.¹⁸¹ In seeking to account for natural phenomena in terms of matter in motion they were all confronted with the problems of explaining what Charleton called 'the multiplicity and the perpetuity of motions ... competent to Atoms'.¹⁸² The earliest strategem was to adopt the auto-diffusive and self-motive principle of light which was such an essential part of the earlier natural theological tradition of light metaphysics. By simultaneously insisting upon the materiality of light, however, the stage was set for the development of the concept of active matter. Digby, White and, for a while, Hobbes,

all relied upon the incessant activity of the sun (and other stars) - emitting a constant stream of invigorating particles of fire and light in the case of the Blackloists - or continually pulsing in systole and diastole in the case of Hobbes.¹⁸³ Hobbes' efforts to shake off this concession to occultism (as Stillingfleet might have put it) led to a long delay in the publication of his De corpore and its ultimate failure on grounds of even greater implausibility.¹⁸⁴ Charleton, showing clear traces of influence from Digby and Hobbes as well as Gassendi and Descartes, simply made self-motion an inherent faculty of matter. Henry More, however, went for an alternative explanatory device - the spirit of nature - which he regarded as providing greater security against atheism as well as providing for the various motions of matter which could not be explained purely mechanically.

In the remaining chapters we will consider the development of the so-called mechanical philosophy among major thinkers in the Restoration period and examine their efforts to account for the activity of matter either in terms of an internal self-motive principle or an external spirit of nature.